Registered at the G.P.O. for Transmission to Canada by Magazine Post.

Vol. 44. Ser. A. Part 12. pp. 401–468. DECEMBER, 1956.

THE REVIEW OF APPLIED ENTOMOLOGY

SERIES A: AGRICULTURAL.

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
56, QUEEN'S GATE, S.W.7.

Price 4s. net.

Service and Regulatory Announcements, January 1951–December 1954.—*S.R.A., P.P.C. & P.Q.* nos. 180–183, 91, 89, 126, 94 pp. [Washington, D.C.] U.S. Dep. Agric., 1954–55.

In addition to announcements relating to quarantines against insect and other pests in the United States, these parts include summaries of plant-quarantine import restrictions in other countries. Summaries or revised summaries of these restrictions are presented for Angola, Australia, Chile and Lebanon in the first part, Austria, Belgium, Canada, the Cape Verde Islands, Costa Rica, Guatemala, India, Italy, Jamaica and Nicaragua in the second, Algeria, Ceylon, France, Western Germany, Hungary, Netherlands New Guinea, New Zealand, the Ryukyu Islands, El Salvador, Taiwan (Formosa) and the United Kingdom (including the Channel Islands) in the third, and Honduras, Japan and the Philippines in the fourth. Supplements to earlier summaries are given for French Morocco [*R.A.E.*, A **41** 13] and Venezuela [**39** 157] in the first, Cyprus [**22** 572; **24** 803], Mauritius [**25** 628], Rumania [**25** 628; **26** 134; **27** 592; **28** 90], Trinidad and Tobago [**39** 157] and Venezuela [**39** 157] in the second, Cuba [**31** 23; **36** 105, etc.], Guadeloupe, French Guiana and Martinique [**26** 385], India, the Republic of Ireland [**36** 184], French Morocco [**41** 13], Norway [**21** 631; **26** 385], Peru [**39** 223], Sweden [**39** 223], Switzerland [**38** 53, etc.], and Turkey [**38** 53, etc.] in the third, and Algeria, Viet-Nam [**26** 385], South Africa [**34** 292] and the United Kingdom in the fourth. A revised supplement to an earlier summary for Holland [**41** 13, etc.] is given in the third.

Bridges (R. G.). **The Fate of labelled Insecticide Residues in Food Products. V. The Nature and Significance of Ethylene Dibromide Residues in fumigated Wheat.**—*J. Sci. Fd Agric.* **7** no. 5 pp. 305–313, 2 figs., 33 refs. London, 1956.

The following is based largely on the author's summary of this part of a series [*cf. R.A.E.*, A **43** 403]. Ethylene dibromide labelled with radioactive bromine (^{82}Br) was used to study the absorption and decomposition of the compound in wheat during fumigation and on subsequent airing and heating [*cf.* **44** 35]. In spite of the high physical sorption of the fumigant and its slow rate of dispersal by airing, there is little chemical reaction between it and the wheat at room temperature. When fumigated wheat that has been imperfectly aired is heated, part of the ethylene dibromide sorbed on it undergoes decomposition to ethylene glycol and inorganic bromide, the remainder being lost by volatilisation; as ethylene glycol is a less toxic material, heating provides a safeguard against possible poisoning due to ethylene-dibromide residues. There is some evidence that the glycol formed reacts with the wheat protein. The hydrogen bromide liberated when ethylene dibromide is decomposed by heating appears to cause some splitting of the starch-granule sheaths. It is concluded that no significant changes appear likely to take place in the nutritive value of wheat as a result of fumigation.

Lubatti (O. F.) & Blackith (R. E.). **Fumigation of agricultural Products. XIV. Treatment of Peas and Beans with Methyl Bromide.**—*J. Sci. Fd Agric.* **7** no. 5 pp. 343–348, 7 refs. London, 1956.

This part of a series [*cf. R.A.E.*, A **44** 213] follows one that was concerned with the fumigation of onion seed for nematode control. In the present paper the authors point out that stored leguminous seeds are commonly

(2242) Wt. PS524/3900 12/56 E.P. Ltd. Gp. 566. [A]

infested by insects in the tropics and record experiments in which pea and bean seeds with moisture contents of 13–19 per cent. were fumigated with methyl bromide at concentration–time products of about 1,000 or 400 mg. per litre per hour and then tested for germination in moist sand in the greenhouse or in soil in the open. The two treatments reduced the germination of the peas by 22·1 and 6·7 per cent. and of the beans by 54 and 25·2 per cent., respectively, moisture content having no substantial effect on the results. It is concluded that peas and beans containing as much as 19 per cent. moisture may safely be fumigated at concentration–time products sufficient to control the insects usually found in stored products, although a moisture content of more than about 15 per cent. will itself cause stored seeds to deteriorate. Inspection of seedlings showing evidence of methyl-bromide injury suggested that peas and beans possess exceptional regenerative powers and that the ability of the plant to remain alive until a destroyed root system can be replaced probably accounts for this. Peas and beans that survive damp storage or fumigation with methyl bromide give essentially the same yield as do untreated seeds.

PARK (T.). **Experimental Studies of Interspecies Competition. II. Temperature, Humidity, and Competition in two Species of *Tribolium*.**—*Physiol. Zoöl.* **27** no. 3 pp. 177–238, 9 graphs, 27 refs. Chicago, Ill., 1954.

In the detailed investigations reported in this second paper of a series [*cf. R.A.E.*, A **39** 409], the effect was examined of all six combinations of temperatures of 34, 29 and 24°C. [93·2, 84·2 and 75·2°F.] and relative humidities of 70 and 30 per cent. on populations of *Tribolium confusum* Duv. and *T. castaneum* (Hbst.) kept in flour separately and in competition with each other. In all, 400 cultures were used, and population counts were made every 30 days. With the exception of *T. castaneum* at 24°C. and 30 per cent. relative humidity, both species persisted indefinitely when kept alone, but they differed in the size of the populations that developed in particular environments as well as in the proportion of adults present. When the two species were kept together, one always eliminated the other, but the one that did so varied with the physical environment, and in some cases was and in others was not the one expected to do so from the trends observed when the species were kept separately. The findings are discussed in the light of general ecology and evolution.

BURNETT (T.). **Influences of natural Temperatures and controlled Host Densities on Oviposition of an Insect Parasite.**—*Physiol. Zoöl.* **27** no. 3 pp. 239–248, 3 graphs, 1 ref. Chicago, Ill., 1954.

In the experiments described, batches of 100 females of *Dahlbominus fuscipennis* (Zett.) were liberated among 16, 25, 49, 100, 196 or 400 cocoons of *Neodiprion sertifer* (Geoffr.) distributed uniformly over plots of short grass each 5 ft. square. The average temperatures to which they were exposed ranged from less than 17·5°C. [63·5°F.] to over 24°C. [75·2°F.], and the results were in general similar to those obtained in laboratory investigations at controlled temperatures [*R.A.E.*, A **42** 245]. The average number of hosts parasitised and, except at the higher temperatures, the average number of eggs laid per 100 females tended to vary as the square root of the number of hosts exposed. At each density, the number and percentage of hosts parasitised and the number of eggs laid per host all increased with temperature up to 24°C. Significantly more cocoons were attacked and significantly

more eggs laid in each when the cocoons provided had been formed only 1–2 months previously than when they had been stored for a year.

NEWTON (C. J.). **Effects of Starvation on Composition of Japanese Beetle Larvae** (*Popillia japonica* **Newman**).—*Physiol. Zoöl.* **27** no. 3 pp. 248–258, 2 graphs, 28 refs. Chicago, Ill., 1954.

The following is based on the author's summary. Comparative analyses were made of the content of various metabolic products in normal third-instar larvae of *Popillia japonica* Newm. and larvae that had been starved for 1–4 weeks at 25°C. [77°F.] over distilled water. It was found that glycogen and ether-extractable fat were reduced by 80 and 71 per cent., respectively, in larvae starved for four weeks and that the greatest losses occurred during the first two weeks. The content of reducing substances, expressed as glucose, decreased by only 25 per cent., but most of the available glucose was presumably lost. There was little loss of nitrogen. The content of alcohol-ether extractable nitrogen increased by 72 per cent. during the four weeks, and this increase may imply the production of phospholipids, though some of the nitrogen may be present as waste nitrogen. The water-soluble fraction not precipitated by tungstic acid increased by 38·1 per cent. of its original weight, and it is suggested that some of this increase is due to the production of waste nitrogen, amino acids and, possibly, glucosamine [*cf. R.A.E.*, A **42** 245]. The water-soluble nitrogen precipitated by tungstic acid and the insoluble nitrogen decreased by 29·8 and 17·1 per cent., respectively. It is concluded that starved larvae utilise body protein as an energy reserve.

LIN (Sping), HODSON (A. C.) & RICHARDS (A. G.). **An Analysis of Threshold Temperatures for the Development of** *Oncopeltus* **and** *Tribolium* **Eggs.** —*Physiol. Zoöl.* **27** no. 4 pp. 287–311, 11 graphs, 18 refs. Chicago, Ill., 1954.

The following is based on the authors' summary. Experiments were carried out to determine the temperature conditions necessary for the development and hatching of the eggs of *Oncopeltus fasciatus* (Dall.) and *Tribolium confusum* Duv. When eggs of *Oncopeltus* were kept at a relative humidity of 75 per cent. and various constant temperatures, the percentages that hatched averaged 24 at 15°C. [59°F.], 65 at 16°C. [60·8°F.], 82 at 17°C. [62·6°F.], about 90 at 20–30°C. [68–86°F.] and 13 at 35°C. [95°F.], but none hatched at or below 14°C. [57·2°F.] or at or above 38°C. [100·4°F.]. Under similar conditions, the percentages for *Tribolium* averaged 0 at 16°C., 21 at 17°C., about 78 at 20–25°C. [77°F.], 80 at 30, 88 at 35 and 27 at 40°C. [104°F.]. A consideration of the time required for hatching when eggs were kept at a temperature below the threshold for part of their development and above it for the rest showed that development occurs at temperatures both above and below the constant-temperature threshold. Low or very high relative humidities appeared to be unfavourable at the threshold temperature, which they raised by 1–2°C. [1·8–3·6°F.].

Attempts to determine whether regular alternation or a single shift between two temperatures would accelerate or retard development gave inconsistent results. When both temperatures were above threshold, no acceleration was observed. When one was below threshold, a calculated acceleration was obtained in some experiments but not in others. Under daily alternations from above to slightly below the constant-temperature threshold, some hatching occurred, even when the average temperature was more than 1°C. below the constant-temperature threshold. When the average temperature

equalled the constant-temperature threshold, the percentage of eggs that hatched was much higher. When the sub-threshold temperature was considerably below the threshold, the duration of the incubation period in *Oncopeltus* was consistent with the possibility that development occurs only at the temperature above the threshold. Provided that the eggs were transferred not more than two or three times between temperatures of 14 and 20 or 25°C., somewhat more than 50 per cent. of their developmental time needed to be at the higher temperature for development to be completed, but eggs that were alternated daily between the two temperatures needed not more than 4 per cent. of the total time to be at 25°C.

Attempts to analyse the nature of the effect of the threshold temperature on the *Oncopeltus* egg gave negative results, but enabled certain possibilities to be eliminated. It did not prevent embryonic development, tissue differentiation or hatching, and no particular stage in egg development appeared especially sensitive to its effect. The few larvae that hatched at or near the threshold temperature seemed not to result from selection within a genetically diverse population; less than 1 per cent. of them survived, and it seems that minimal conditions cause the production of debilitated individuals.

Heie (O. E.). **Studies of the Overwintering of *Myzus persicae* Sulzer in Denmark and the Occurrence of this Aphid in Beet Fields.**—*Trans. Danish Acad. tech. Sci.* 1954 no. 1, 34 pp., 4 col. pls., 2 figs., 24 refs. Copenhagen, 1954.

The following is based on the author's summary of this account of observations carried out chiefly in 1950–52. *Myzus persicae* (Sulz.) overwinters in Denmark in two ways. The first is in the winter egg on peach and possibly on other species of *Prunus*. Considerable numbers of *M. persicae* flew to Japanese cherry (*P. serrulata*) in the autumn of 1951, and though no Aphids were observed on trees of that species in the spring of 1952, immature fundatrices transferred to them from peach in April gave rise to adults that reproduced. In another area, apterae and immature Aphids, some with wing-pads, were found among the young leaves and flowers of *P. serrulata* in May, and Aphids, including alates, were also found in spring on *P. davidiana* and a peach hybrid. The autumn migration to peach occurred in September–November; maximum numbers were present in October, and the oviparae became adult about the middle of that month. Males were not observed until the end of October, and the first eggs were found in early November. Hatching began in early April and the first alates appeared in May.

M. persicae also overwinters as mature and immature parthenogenetic females on herbaceous plants in greenhouses and in beet clamps. The occurrence of the Aphid on uncovered plants in the open has been observed until January on cabbage and February on beet, but not later. Beet clamps are numerous in Denmark and are considered to constitute the most important overwintering sites, the percentages infested being 55 in the spring of 1950, 16 in 1951 and 34 in 1952. For the years 1949–52, 33, 25, 24, 40 and 47 per cent. of clamp examinations in February, March, April, May and June, respectively, showed infestation. Some alates were found in the clamps in April, but substantial numbers did not occur until May. The size of the population in beet fields in autumn does not appear to influence the number of Aphids in clamps in the following spring, because winter mortality is high. Differences in clamping methods and in conditions in the clamps must be assumed to account for the uneven occurrence of the Aphid in different clamps. Though some individuals were found in all parts of clamps in

winter and spring, large numbers were frequent only where the cover was thin or had been removed.

In autumn, *M. persicae* occurred in fields of fodder beet almost exclusively on plants showing symptoms of virus yellows, particularly on the older leaves. Infection with the virus may induce a plant condition enabling *M. persicae* to reproduce more quickly than on healthy plants, but this needs confirmation. On young plants and on older beets not showing symptoms of yellows, the greatest numbers were found on young leaves. Fewer Aphids per plant occurred in dense than in open plant stands.

WAGN (O.). **Bladtaeger (Miridae) og forekomst af frø uden kim hos skaermblomstrede (Umbelliferae).** [Mirids and the Occurrence of embryoless Seed in Umbelliferae.]—*Tidsskr. Plantcavl* **58** pp. 58–90, 9 figs., 26 refs.; also as *Beretn. Forsøgsv. PlKult.* no. 485. Copenhagen, 1954. (With a Summary in English.)

Poor germination of the seeds of carrot and related crops is common in Denmark, and as the feeding of *Lygus lineolaris* (P. de B.) (*oblineatus* (Say)) has been found to injure the embryos of the seeds of umbelliferous plants in the United States [*cf. R.A.E.*, A **40** 155, etc.], investigations were begun in 1951 to ascertain whether Mirids were similarly responsible in Denmark. Sweeping in fields of carrots grown for seed in 1952–53 showed that *Lygus campestris* (L.) and *L. kalmii* (L.) were by far the commonest species present, the first being the more numerous, and that *L. rugulipennis* Popp. (*pubescens* Reut.), *L. pratensis* (L.) and *Calocoris norvegicus* (Gmel.) made up most of the remainder. The adults of these five species are briefly described, and notes are given on their bionomics. The four species of *Lygus* hibernate in the adult stage, and field observations suggested that they have two generations a year. *C. norvegicus* is reported in the literature to overwinter in the egg. The bugs suck the developing seeds, and females of the first two species were observed depositing eggs in the ovaries, round the base of the pistils.

The damage to the seeds was studied by caging adults of one or more species on individual umbels of carrot and other umbelliferous crops after the flowers had withered, examining the seeds after harvest for damage to the embryos, and testing them for germination. The bugs were not affected by confinement and readily reproduced. The results indicated that considerable proportions of the embryos were destroyed by *L. rugulipennis* and *L. pratensis* alone and by *L. campestris* and *L. kalmii* together, and that the nymphs of the last two caused similar damage. Injury was slight when the bugs were confined on seeds with fully developed embryos.

In experiments on the prevention of damage, some reduction in seed injury was given by suitable sprays of DDT, BHC or chlordane, particularly when the seeds on the later-developing umbels were considered, and treatment with a spray of 0·1 per cent. DDT applied once or twice at an interval of ten days shortly after flowering, which increased germination by about 10 per cent., is recommended. A DDT dust might be equally effective [*cf.* **38** 184].

MÜHLE (E.) & KÖNIGSMANN (E.). **Zur Frage der Kümmelvergrünung.** [The Problem of Greening of Caraway.]—*Z. PflKrankh.* **61** pt. 8 pp. 396–402, 4 figs., 10 refs. Ludwigsburg, 1954. (With a Summary in English.)

Aceria carvi (Nal.) was recently found causing a distortion of the flowers and leaves of caraway (*Carum carvi*) in Germany and thus reducing the yield of seed. The symptoms caused are described in detail.

LEKANDER (B.). **Om märgborrens och större tallvivelns uppträdande i skog tidigare angripen av tallfly- och tallmätarlarver.** [The Occurrence of *Myelophilus piniperda* and *Pissodes pini* in Forest previously attacked by Larvae of *Panolis flammea* and *Bupalus piniarius*.]—*Medd. SkogsforsknInst.* **44** (1954) no. 3, 31 pp., 13 figs., 8 refs. Stockholm, 1955. (With a Summary in German.)

In view of the lack of detailed information as to the injuriousness of secondary insect pests in forests, advantage was taken of two outbreaks of Lepidoptera on pine in Sweden to study subsequent infestation by other insects. The first outbreak was in a forest in southern Sweden, where the trees became heavily infested by *Panolis flammea* (Schiff.) and to a less extent by *Lymantria monacha* (L.) in 1947. A survey in the autumn of that year showed the presence of at least one pupa of *Panolis* per sq. metre (the level at which control is recommended) over some 2,500 acres and of 3·6 per sq. metre over the central area of complete defoliation. The forest was dusted with DDT at an average rate of 11·5 lb. per acre from a helicopter in the summer of 1948, and practically complete control was obtained, only one pupa being found in the ensuing autumn. A plot was established for the study of secondary pests on the weakened trees, and observations showed the presence of *Myelophilus* (*Blastophagus*) *piniperda* (L.). The 3,858 trees on the plot were investigated singly, and attacks recorded each year from 1948 to 1950. In all, 1,061 trees were killed by the bark-beetle, 82 per cent. of them in the last two years. The average diameter of the killed trees was 9·8 cm., as compared with 11·9 cm. for the whole plot, and was remarkably constant from year to year. Attempted infestation failed on 310 trees, because of resin flow, and of the total of 1,371 trees attacked, 22 per cent. survived the first attempt, though almost all of these became infested in the following years and many were killed. Some infestation by *Pissodes pini* (L.) also developed on the plot, especially on the smaller trees, and 352 trees with an average diameter of 6·4 cm. were killed by this weevil.

The other outbreak studied was in a forest area in central Sweden in which heavy infestation by *Bupalus piniarius* (L.) developed in early 1940 and continued until 1945, when it died out from unknown causes. Plots were established in that year for the study of secondary pests, and infestation by *M. piniperda* occurred. Of the 3,676 trees under observation, 1,272 were killed by this bark-beetle in 1945–46, and the initial attack failed on 195, of which 25 per cent. were attacked a second time and killed. The same tendency for the diameter of the trees infested to be less than the average for the stand was observed.

It is concluded that secondary forest pests such as *M. piniperda* cause considerable loss of timber, the amount varying with the particular conditions of each outbreak and depending mainly on the amount of defoliation previously suffered by the trees and the original population density of the secondary pest, which was high in the two cases described. In order to prevent such damage, early control of the primary, leaf-feeding pest is essential.

LEKANDER (B.). **Skadeinsekternas uppträdande i de av januaristormen 1954 drabbade skogarna.** [The Occurrence of Insect Pests in the Forest struck by Storm in January 1954.]—*Medd. SkogsforsknInst.* **45** pt. 2 no. 3, 35 pp., 2 maps, 7 refs. Stockholm, 1955. (With a Summary in German.)

Severe storms passed over central Sweden on 3rd–4th January 1954 and caused serious damage in forests, some 40 million trees being blown down.

Clearance could not be completed before the summer, and observations were therefore made in 125 sample areas for the occurrence of insect pests on the fallen timber. The most important were *Ips* (*Pityogenes*) *chalcographus* (L.) and *I. typographus* (L.) on spruce and *Myelophilus* (*Blastophagus*) *piniperda* (L.) and *M.* (*B.*) *minor* (Htg.) on pine, and breeding was so rapid, particularly that of *I. typographus*, that much damage seemed likely to occur. Infestation varied with the degree to which clearance had been effected, and was greater on partly cleared areas than on those not yet reached. *Myelophilus* was fairly evenly distributed over the storm-affected area, but *I. typographus* was commonest in the north. A serious outbreak of this bark-beetle in 1955 seemed probable.

Lekander (B.) & Rennerfelt (E.). **Undersökningar över insekts- och blånadsskador på sågtimmer.** [Investigations on the Damage caused by Insects and Blue-stain Fungi to Saw Timber.]—*Medd. Skogsforskn-Inst.* **45** pt. 2 no. 8, 36 pp., 24 figs., 11 refs. Stockholm, 1955. (With a Summary in English.)

In view of the damage caused to timber in storeyards and sawmills in Sweden by Coleoptera and blue-stain fungi, the authors give lists of the beetles and fungi concerned, with records of the amount of injury caused based on observations in various districts. The fungi are transmitted either by air or by insects, and the Scolytids, *Myelophilus* (*Blastophagus*) *minor* (Htg.), *Ips acuminatus* (Gylh.), *I. typographus* (L.) and *Trypodendron lineatum* (Ol.), are recorded as vectors of them, the first two on pine, the third on spruce and the fourth on both pine and spruce. Methods of reducing fungus infection are suggested from the results of tests in one locality, and include spraying the logs with DDT to protect them from Scolytids, which gave very good results.

Barnes (H. F.) & Nayar (K. K.). **The Black Medick or 'Trefoil' Gall Midge.**—*Plant Path.* **3** no. 2 pp. 51–54, 1 pl., 1 graph. London, 1954.

In the spring of 1953, a field of *Medicago lupulina* in Hertfordshire was found to be widely infested by *Dasyneura lupulinae* (Kieff.). The presence of the galls did not impair subsequent growth, and as similar galls were later observed in two other places, this Cecidomyiid is probably not uncommon in eastern England. In laboratory observations, galls collected in March and kept in the insectary and infested plants transferred to an unheated glasshouse gave rise to adults from 17th May to 10th July and from about 7th May onwards, respectively. Females were more than twice as numerous as males in the glasshouse, and some adults of *Lestodiplosis* sp. and a few Hymenopterous parasites were also obtained. In 1946, emergence in the insectary from galls collected in Suffolk had occurred between 24th April and 27th May, when 14 males and 84 females of *D. lupulinae* and some adults of *Lestodiplosis* were also obtained. In 1953, the adults that emerged were allowed to oviposit on the plants on which they had developed or on others, and subsequent generations emerged during July and between 16th August and 20th September; well developed galls were again present in mid-September, but no further emergence took place that year. Eggs were laid in the axillary or terminal buds, which subsequently developed into green or reddish pea-sized galls. Infestation first became apparent as a reddening of the plant tissue about nine days after oviposition, and the galls were well developed about a fortnight later. The galls usually contained up to about

20 larvae or pupae each, but 141 larvae were found in one. Larvae of the third generation, and probably also late individuals of the second, overwintered in the galls. Complete development occupied 35–46 days, but is probably more variable in the field. Adults were present for about 2–3 weeks when the eggs from which they developed were laid within a day or two, but for over five weeks when the oviposition period had been protracted. Under field conditions, there must be considerable overlapping of generations, particularly in late summer. Plants and seedlings infested in the laboratory made good growth under favourable conditions, though slow-growing plants subjected to successive attacks became stunted and repeated heavy attacks prevented flowering; such severe infestation is not likely often to occur in the field. *D. lupulinae* greatly resembles *D. ignorata* (Wachtl), which makes similar galls on lucerne, but attempts to induce it to oviposit on lucerne were unsuccessful.

Collingwood (C. A.). **The Hop Root Weevil.**—*Plant Path.* **3** no. 2 pp. 63–65, 1 pl., 1 map. London, 1954.

Epipolaeus caliginosus (F.) has occasionally been recorded on hops in various parts of Britain [*cf. R.A.E.*, A **26** 613; **38** 472] but appears to be commonest in Worcestershire and Herefordshire, where it has been known since 1935 and 1949, respectively; its distribution in these two counties in 1953 is shown on a map. Observations showed that the wingless adult weevils occur throughout the year, but are most abundant in late summer and autumn; they feed under soil clods or among the basal underground parts of the bine. Eggs are laid singly in the basal parts of the bine or in the rootstock; they are present from mid-August to May, but are most numerous during September–November. The larvae tunnel first in the cortex and later in the pith and pupate in the rootstocks after 9–18 months; pupae are present from early June until mid-September, and the pupal stage lasts 2–3 weeks. In heavily infested hop-yards, many bines break easily when pulled after cropping and over 20 larvae may be found per rootstock. Damage usually reduces plant vigour, and is fatal in some years. Its extent usually becomes apparent only in spring, when the plants are trimmed by cutting away the swollen bases of the bines, which are used as cuttings, and the larval burrows are exposed. Many larvae are removed during this process, but they cannot be eradicated by it, since most are in the rootstock.

In laboratory tests on control, adults were killed more readily by BHC than by DDT, but dusting or spraying with DDT or BHC and watering with parathion in late summer were ineffective in the field. Promising results were given by a dust of 3·5 per cent. BHC applied to the surface of the soil on 10th June 1950 at 1 cwt. per acre, before the plants were ridged up. In August 1951, 123 larvae were found in 20 plants from the untreated area and only 21 in 16 from the treated area; pupae and adults were also less numerous in the latter, but the main effect appeared to be the prevention of oviposition. In some seasons, adults may not emerge for several weeks after application of the dust, but will nevertheless eventually come into contact with it; treatment after earthing up fails probably because the adults do not always come to the surface of the soil. Since all the larvae do not complete their development in one year, treatment is necessary over two or more seasons. Soaking infested cuttings in an emulsified solution of 0·2 per cent. DDT was ineffective in controlling the larvae on one farm, but 0·04 per cent. parathion used in the same manner gave some control. Larvae were destroyed when cuttings were soaked in water at 44°C. [111·2°F.], and the cuttings survived temperatures of 46°C. [114·8°F.] for 15 minutes without serious check. Treatment at 45°C. [113°F.] therefore appears

possible, but the cuttings should be cooled and planted without delay, and the method is probably commercially practicable only for special stocks.

Edwards (C. A.). **Experiments on the Control of Pea Moth.**—*Plant Path.* **3** no. 2 pp. 66–67. London, 1954.

Emulsion sprays containing DDT give good control of *Cydia* (*Laspeyresia*) *nigricana* (Steph.) on peas in Britain [*cf. R.A.E.*, A **36** 263], but as water is not readily available in some districts, the value of dusts was tested in experiments in Wiltshire in 1952–53. In a test in 1952 to determine the best times of application, a dust of 5 per cent. DDT was applied to three crops sown on 25th and 30th April and 16th May two or ten days after the onset of flowering, or both, at a rate of about 1 cwt. per acre. The earliest crop escaped attack, but infestation was heavy on the latest one. The single application on the second day after flowering had no significant effect on the percentage of peas infested at picking time, but that on the tenth day reduced it from 18·5 to 8 on the intermediate crop and from 44 to 22 on the late one, and both reductions were significant; two applications were only slightly more effective. In 1953, the DDT dust was compared with a dust of 1·5 per cent. dieldrin used at about 66 lb. per acre and an emulsion spray of 0·25 per cent. DDT at about 140 gals. per acre. Applications were made about ten days after the beginning of flowering, when the first pods were setting, to three crops sown on 26th April and 2nd and 10th May. All treatments gave significant reductions in infestation on the earliest crop, the DDT dust resulting in complete control and being significantly better than the spray. It was the only treatment to give a significant reduction on the intermediate crop, and it and the spray were the only ones to do so on the late crop, the spray being superior to the dust. In a supplementary test, a spray of 3 lb. 25 per cent. wettable malathion in 150 gals. water per acre gave no control.

Broadbent (L.), Burt (P. E.) & Heathcote (G. D.). **The Control of Potato Virus Diseases by Insecticides.**—*Ann. appl. Biol.* **44** no. 2 pp. 256–273. 18 refs. London, 1956.

The following is largely based on the authors' summary. Experiments were carried out at Rothamsted in 1950–54 to ascertain whether the spread of leaf-roll virus and virus Y in potato crops could be reduced by applying insecticides against their Aphid vectors. The crops were disease-free, except for small numbers of deliberately introduced infected plants, and were sprayed at intervals of 10 or 14 days, according to the stage of growth of the plants, with a tractor-mounted sprayer at 100 gals. per acre. The Aphids present were *Myzus persicae* (Sulz.), which is the principal virus vector; *Macrosiphum solanifolii* (Ashm.) (*euphorbiae*, auct.) and *Aphis nasturtii* Kalt. Disease spread was estimated by growing tubers taken from the five plants on either side of each introduced infector. The results, which are described in detail, confirmed those obtained by other workers and indicated that the spread of the leaf-roll virus is more affected than that of virus Y by Aphid control [*cf. R.A.E.*, A **43** 61; **44** 282, 349] and that the decrease in the incidence of disease is mainly due to the prevention of spread within the crop. Sprays of 0·2 per cent. DDT, 0·1 per cent. endrin, 0·125 per cent. schradan, 0·12 per cent. mipafox (bis(monoisopropylamino) fluorophosphine oxide), 0·3 per cent. malathion, 0·1–0·125 per cent. parathion and 0·24 per cent. Systox (50 per cent. diethyl 2-(ethylmercapto-ethyl) thiophosphate [detected] gave good control of the Aphids (as estimated by counts

of apterae on the crops), prevented the spread of leaf-roll and decreased the spread of virus Y, but 0·05 per cent. dieldrin and 0·05–0·2 per cent. toxaphene were ineffective. The persistence of DDT, endrin, malathion, parathion and Systox was investigated by enclosing groups of five adult apterae of *Myzus persicae* on the stems of sprayed plants just before a further application was due and counting the Aphids present eight days later. It was found that all the insecticides remained highly effective for at least the period between applications on crops that were not growing rapidly, but that on rapidly growing plants, there were differences, Systox, which has systemic action, remaining effective for longer than the contact insecticides, of which DDT and endrin were the most persistent.

Howe (R. W.). **The Biology of the two common Storage Species of *Oryzacphilus* (Coleoptera, Cucujidae).**—*Ann. appl. Biol.* **44** no. 2 pp. 341–355, 6 graphs, 12 refs. London, 1956.

The following is largely based on the author's summary. Evidence is presented that *Oryzacphilus surinamensis* (L.) and *O. mercator* (Fauv.) are distinct species; they did not interbreed in laboratory tests and unpublished work by J. Slow showed that they can be distinguished by the relative lengths of eye and temple and by the male genitalia. Both are imported into Britain in considerable numbers, *O. surinamensis* chiefly on cereal products and *O. mercator* chiefly on oilseed products. *O. mercator* is killed by cold in Britain, but *O. surinamensis* can survive and not infrequently becomes a pest.

In laboratory investigations on their bionomics [*cf. R.A.E.*, A **14** 634; **29** 186; **32** 185], eggs of both species hatched at constant temperatures ranging from 17·5 to 40°C. [63·5 to 104°F.]. Egg mortality was high below 20°C. [68°F.] and above 37·5°C. [99·5°F.]. Low relative humidity increased egg mortality, but did not affect the duration of the egg stage, which was shortest (about two days) at 35°C. [95°F.] and above. On wheatfeed, the larva of *O. mercator* developed more slowly than that of *O. surinamensis* and was more sensitive to low relative humidities. The optimum temperature for *O. mercator* was about 30–32·5°C. [86–90·5°F.] and that for *O. surinamensis* about 30–35°C. [86–95°F.], at which the larval stage lasted up to 15 and 12·5 days, respectively. Low humidity increased the length of the larval period and *O. mercator* died at 10 per cent. relative humidity except at temperatures between 25°C. [77°F.] and 32·5°C. The shortest pupal period in both species (about four days) occurred at temperatures above 35°C. On coconut meal at 30°C. and 70 per cent. relative humidity, *O. mercator* developed more rapidly than *O. surinamensis*, which could not develop on this food at lower humidities. *O. mercator* developed more slowly on coconut meal than on wheatfeed. Neither species completed development on groundnut meal unless yeast powder was added. There were usually three larval moults, but a few individuals had four or two. The longer larval period of *O. mercator* is explained partly by the slightly greater length of its individual instars and partly by an increased tendency towards only two larval moults in *O. surinamensis*. The pre-oviposition period of both species at 30 and 33°C. [91·4°F.] lasted 3–8 days and was usually about five. *O. mercator* reached a peak of three eggs per female per day and *O. surinamensis* one or 0·10 per female per day by the end of a week, and these rates were maintained for a month, about 200 and 370 eggs per female being laid, respectively. About 95 per cent. of the eggs hatched.

Both species increase rapidly in the tropics, but neither can do so very quickly in unheated stores in Britain. *O. surinamensis* is a pest because

it can survive in large numbers in the fabric of warehouses and multiply rapidly when warm or actively heating produce becomes available.

Howe (R. W.). **The Effect of Temperature and Humidity on the Rate of Development and Mortality of** *Tribolium castaneum* **(Herbst) (Coleoptera, Tenebrionidae).**—*Ann. appl. Biol.* **44** no. 2 pp. 356–368, 3 graphs, 17 refs. London, 1956.

The following is based on the author's summary. The speed of development and the developmental mortality of *Tribolium castaneum* (Hbst.) in fine wheatfeed were studied at temperatures between 15 and 40°C. [59 and 104°F.] and relative humidities of 10–90 per cent. No hatching occurred at any humidity at 17·5°C. [63·5°F.] or less or at 10 per cent. relative humidity at 40°C. Under all other conditions, about 80 per cent. of the eggs hatched. The duration of the egg stage was not affected by humidity but varied inversely with temperature from 2·6 days at 37·5°C. [99·5°F.] to 13·9 days at 20°C. [68°F.]. Larvae did not give rise to normal adults at 20°C. or at 40°C. when the relative humidity was 30 or 90 per cent. Pupae were formed at 20°C. and 70 per cent. relative humidity, but did not result in normal adults. The rate of larval development was affected by both temperature and humidity and was highest at the maximum humidity used at any temperature and at 35°C. [95°F.] for all relative humidities. Larval mortality was less than 20 per cent. except at 40°C. and at combinations of low humidity and low temperature. The results agree with those of other investigators using similar foodstuffs [*cf. R.A.E.*, A **24** 493; **33** 235]. Split groundnuts were used as the food in one supplementary series of experiments with larvae at 30°C. [86°F.] and in another at 70 per cent. relative humidity. On this food, the larvae were much more sensitive to humidity and were unable to develop at 20 or 40°C. combined with 70 per cent. relative humidity. Under all conditions, development was slower and mortality higher than on wheatfeed. The pupal stage was not affected by humidity or by the food of the larvae and was shortest at 37·5°C. Park found that cultures of *T. castaneum* became extinct at 24°C. [75·2°F.] and 30 per cent. relative humidity [*cf.* **44** 402]. These conditions fell within the zone in which development was possible in the present work, and it is suggested in a discussion of the possible causes of the discrepancy that the species may fail in cultures because large numbers of eggs are eaten by the adults.

Chauvin (R.). **Physiologie de l'insecte. Le comportement, les grandes fonctions, écophysiologie.**—2nd edn. (revd.), $9\frac{3}{4} \times 6\frac{1}{4}$ ins., 917 pp., 107 figs., many refs. Paris, Inst. nat. Rech. agron., 1956. Price *Fr.* 3,500.

This revised edition of a work already noticed [*R.A.E.*, A **38** 345] has been expanded and considerably rewritten to include the results of recent research in several branches of insect physiology. The arrangement of the chapters remains the same, and the revision has been most extensive in the sections on the integument, moulting, diapause, sex hormones and behaviour.

Eastop (V. F.). **Selection of Aphid Species by different Kinds of Insect Traps.**—*Nature* **176** no. 4489 p. 936. London, 1955.

Three yellow trays and a suction trap were operated close to one another for more than two years near Kikuyu, Kenya. The suction trap is believed

to take a fairly accurate sample of Aphid density, and the ratios of the catches of some 25 species in the trays to those in the trap are shown in a table. They ranged from 30·7 for *Toxoptera citricidus* (Kirk.) to 0·5 for *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris), and were in general lower for species that feed on grasses and sedges than for those that feed on dicotyledons. Statistical analysis of the catches from hour to hour showed that sunshine increased the numbers caught in the trays in comparison with those in the suction trap.

MARAMOROSCH (K.). **Incubation Period of Aster-yellows Virus.**—*Amer. J. Bot.* **40** no. 10 pp. 797–809, 1 fig., 41 refs. Lancaster, Pa., 1953.

The following is largely based on the author's summary. The aster-yellows virus alternates in nature between plant and insect hosts, and its multiplication in both has been demonstrated experimentally [*cf. R.A.E.*, A **29** 502]. The incubation period was studied in China aster (*Callistephus chinensis*) and the aster leafhopper (*Macrosteles fascifrons* Stål). In the plant, the shortest incubation periods were nine days in a temperature-control chamber at 25°C. [77°F.] and eight days in a greenhouse in sunny weather at the same average temperature. The minimum incubation period at 20°C. [68°F.] was 18 days, and no plants became infected at 10°C. [50°F.]. The length of the incubation period was independent of the number of infective insects used and the period for which they fed on the plant, but a long incubation period was occasionally observed in the first plant of a series infected by an insect into which the virus had been mechanically injected. The virus could be recovered from plants one day before symptoms appeared, but not earlier, and its movement from infected leaves to the rest of the plant began within a day.

In the insect, the incubation period lasted 16, 12 and 11 days at temperatures of 20, 25 and 30°C. [86°F.], respectively, and was not completed within 45 days at 10°C. Immediate transmission was observed in insects into which large doses of virus had been injected. Low temperature had less effect on the acquisition and transmission of the virus than on the incubation period; transmission gradually ceased at 10°C., but efficiency of acquisition was less at 30° than at 10 or 25°C. Individual variations in the ability of insects to transmit the virus were observed, regardless of temperature. The variations in incubation period in insects into which equal doses of a given dilution had been injected were recorded, and it is concluded that only the shortest period should be adopted as a comparative measure of virus concentration; groups of insects rather than individuals should therefore be used. The relation of dosage to incubation period in insects infected by injection was studied by varying either the volume or the concentration of the material injected, and higher doses resulted in shorter incubation periods in both cases. The evidence for the occurrence of developmental stages in the life-cycle of the virus is discussed.

VAN HOOF (H. A.). **Verschillen in de overdracht van het bloemkoolmozaiekvirus bij** *Myzus persicae* **Sulzer en** *Brevicoryne brassicae* **L.** [Differences in the Transmission of Cauliflower Mosaic Virus by *M. persicae* and *B. brassicae*.]—*Tijdschr. PlZiekt.* **60** pt. 6 pp. 267–272, 6 refs. Wageningen, 1954. (With a Summary in English.)

Three series of tests were carried out in Holland to investigate differences in the transmission of the cauliflower mosaic virus by *Myzus persicae* (Sulz.) and *Brevicoryne brassicae* (L.), the latter being an important vector [*cf.*

R.A.E., A **43** 179]. In the first, Aphids that had fasted for three hours were allowed to feed for five minutes on a source of infection and then singly for periods of five minutes on five successive healthy cauliflower plants. Of the 50 examples of *M. persicae* used, 11 transmitted the virus to the first plant only, four to the second only, one to the third only and one to the first, second, third and fifth. Of the 33 of *B. brassicae*, seven transmitted it to the first plant only, two to the first and second, one to the second only, three to the third and two to the fourth. Since most of the Aphids infected only the first plant on which they fed, the virus would appear to be of the non-persistent type [*cf.* **35** 205, etc.].

In the second series, the Aphids were placed on infected plants without a period of fasting or after fasting periods of 1, 5 or 20 hours, and allowed to feed for periods ranging from two minutes to 24 hours; they were then placed in groups of three on healthy cauliflower plants and left for 24 hours. With *M. persicae*, maximum transmission was obtained with infection feeding periods of two minutes, the numbers of plants infected (out of a possible 30) by Aphids that had fasted for 0, 1, 5 and 20 hours before the feed being 15, 18, 16 and 7, respectively. The corresponding figures were 13, 15, 9 and 9 for infection feeds of 15 minutes, and 6, 11, 6 and 4 for infection feeds of 24 hours. With *B. brassicae* subjected to the same fasting periods, the numbers of plants infected were 21, 16, 21 and 17, respectively, for infection feeds of two minutes, 26, 20, 24 and 17 for 15 minutes, 23, 25, 24 and 18 for one hour, 27, 28, 25 and 23 for five hours, and 29, 24, 25 and 24 for 24 hours. The period of 20 hours' fasting caused considerable mortality of the Aphids. Transmission by *M. persicae* was thus little affected by preliminary fasting but was favoured by short feeding periods on the source of infection. That by *B. brassicae* appeared to be hindered by prolonged fasting and favoured by long infection feeding. These results would exclude the virus from the non-persistent group.

Since the results obtained indicated that the virus is rapidly inactivated in *M. persicae*, a third series of tests was made, in which examples of *M. persicae* were starved for three hours, allowed to feed on infected material for five minutes, and then starved for 0–24 hours. Others had no preliminary fast and were allowed an infection feed of 24 hours before fasting for similar periods, and all were transferred to healthy cauliflower and allowed to feed for 24 hours. Transmission was greatly reduced by the second period of fasting and none was obtained when it lasted longer than four hours. When examples of *B. brassicae* that had not fasted were allowed infection feeds of 24 hours, made to fast for 0–24 hours and then fed in groups of five for 24 hours on healthy cauliflower, the number of plants infected out of a possible 30, and (in brackets) the duration in hours of the post-infection fast, were 28 (0), 27 (2), 19 (4), 20 (6), 16 (8) and 12 (10). Four plants out of ten were infected in one test in which the post-infection fast lasted 24 hours. Inactivation of the virus was thus rapid in *M. persicae* and very slow in *B. brassicae*, and it is thought that this may be due to adaptation between the latter Aphid and the virus.

Fransen (J. J.) & Kerssen (M. C.). **Biologisch onderzoek van dieldrin-residu's.** [Bioassay of Dieldrin Residues.]—*Tijdschr. PlZiekt.* **60** pt. 6 pp. 276–280, 1 ref. Wageningen, 1954. (With a Summary in English.)

The tests described were carried out in view of the possibility of using *Calandra granaria* (L.) to assess dieldrin residues, and the mortality percentages shown were calculated according to Abbott's formula [*cf. R.A.E.*, A **13** 331]. In the first test, groups of 100 weevils were allowed to crawl for various periods over the dried residues from 2 cc. of various concentrations

of dieldrin in acetone applied to petri dishes about 3·5 ins. in diameter, and they were then removed and kept at 21°C. [69·8°F.] for up to seven days, in most cases with wheat as food, since there was 36 per cent. mortality in a week when untreated individuals were kept without food. When the weevils were exposed to the residues for one hour and kept with food for seven days, the mortality percentages increased fairly regularly from 34 for 0·14 mmg. dieldrin per sq. cm. to 98 for 17·64 mmg., but when they were exposed for 24 hours and kept for three days without food or exposed for one or three days and kept with food for five days, mortality was irregular. At the time of examination, 99–100 per cent. of the weevils were dead or dying in all groups exposed to residues of 1·1 mmg. or more per sq. cm. It is concluded that at least seven days must elapse between the exposure of the weevils and the final mortality counts if accurate results are to be obtained.

In the second test, weevils were confined on treated glass plates under small inverted funnels with a diameter of about 2 ins. Dieldrin was applied to the plates to give 0·54 mmg. per sq. cm., either as a continuous film or in 5, 10 or 20 droplets per funnel. The weevils were exposed to the residues for 21 hours and then kept at 21°C. for six days, after which the mortality percentages were 85, 89 and 89·5 for the droplet residues and 92 for the film, so that little difference was detectable. In the third test, weevils were similarly exposed for 1, 3 or 20 hours to film or droplet residues giving two levels of deposit and the mortality observed after seven days. After exposure to the films and (in brackets) droplet residues, the mortality percentages were 83·5, 95 and 99 (13, 18·5 and 93·5), respectively, for residues of 0·54 mmg. per sq. cm., and 64, 90 and 98 (6, 15 and 84), respectively, for 0·27 mmg. It is concluded that for bioassay of the quantity of toxicant in a film residue, the exposure period should not be more than three hours, but that in the case of droplets it should be between three and 20 hours. To determine the optimum exposure for assessing droplet rates, weevils were exposed for periods ranging from 1 to 21 hours to deposits from 5, 10 or 20 drops per funnel, the amount of toxicant being 0·5 mmg. per sq. cm. in each case. Mortality counts were made after seven days, and showed that differences in mortality between 5 and 10 droplets per funnel were large for exposure periods of up to 18 hours and between 10 and 20 droplets for exposures of up to three hours. The probability of contact with droplet deposits increases with droplet density and exposure period, and the mean error of the mortality percentages obtained is shown to be a measure of droplet density, provided that the exposure period is not too long.

When dieldrin was applied in droplets to cabbage leaves of two sorts, one having a thick and one a thin waxy layer, and to glass plates, the insecticide did not penetrate the wax and there were no differences after 24 days in the toxicity of any of the residues.

Martorell (L. F.) & Bangdiwala (J. S.). **Sucrose Content of Sugarcane as affected by Moth-borer, *Diatraea saccharalis* (Fabricius), Infestation.** —*J. Agric. Univ. P. R.* **38** no. 1 pp. 22–37, 4 graphs, 7 refs. Río Piedras, P.R., 1954. (With a Summary in Spanish.)

The following is substantially the authors' summary. More than 1,000 samples of sugar-cane stalks were milled and the juice analysed in an attempt to obtain a more accurate estimate of the losses caused by infestation of sugar-cane in Porto Rico by *Diatraea saccharalis* (F.). Statistical analyses showed that the highest percentage of sucrose is found in the central portion of the cane, less is found at the base and the least in the top internodes, and that by using a factor of 0·03549, which was found to represent the loss of available sucrose per 1 per cent. of joint infestation, the losses of sucrose

caused by moth-borer damage in any given area can be calculated. It is estimated that the average annual losses in Porto Rico amounted to about 2½ million dollars in 1940–51.

MARTORELL (L. F.) & BURLEIGH (C. H.). **Ineffectiveness of the Overhead-irrigation Method for the Application of Insecticides to control the Sugarcane Moth Stalk-borer,** *Diatraea saccharalis* **(Fabricius).**—*J. Agric. Univ. P. R.* **38** no. 1 pp. 38–60, 4 figs. Río Piedras, P.R., 1954. (With a Summary in Spanish.)

The following is taken from the authors' summary. An overhead irrigation system for sugar-cane was established at Santa Isabel in Porto Rico, and made possible the application of fertilisers dissolved in water and also of insecticides for the control of insect pests. Experiments were carried out in 1950 and 1951, in which the system was used to apply 13 insecticides against *Diatraea saccharalis* (F.). The insecticides were applied four times each season, at intervals of 15 days, but the results showed that the method was completely ineffective for the control of this insect, probably owing partly to the large amount of water used, which reduced the concentration below the level of effectiveness.

HENDERSON (C. F.). **Overwintering, Spring Emergence and Host Synchronization of two Egg Parasites of the Beet Leafhopper in southern Idaho.** —*Circ. U.S. Dep. Agric.* no. 967, [1+] 16 pp., 7 figs., 6 refs. Washington, D.C., 1955.

Aphelinoidea plutella Gir. and *Abbella subflava* Gir. were the most abundant of the parasites reared from the eggs of *Circulifer tenellus* (Baker) in southern Idaho during observations in 1932–37. The greatest populations of these Trichogrammatids developed in the summer breeding areas of the leafhopper where Russian thistle (*Salsola kali*) was its main food-plant, and since the parasites commonly overwinter as pupae in the host eggs on this plant, it was used for studies of the overwintering and spring emergence of the two species. The work was carried out in the laboratory by means of apparatus and techniques already noticed [*R.A.E.*, A **30** 150], and the following is based on the author's summary of the results.

Most of the pupae of the first and some of those of the second, third and fourth generations of both parasites gave rise to adults during the season of development, the remainder going into diapause until the following spring. The diapause was broken, presumably in late autumn, by low temperatures. After it had been broken, a period of 6–7 days at 80°F. was required before adult emergence began, and 50 per cent. of the adults emerged after about 8½ days. When emergence from field-collected material began within 24 hours and 50 per cent. of the parasites had emerged in four days, it could be assumed that emergence had begun in the field. The percentage of females among the adults reared was 52 for *Abbella* and 63 for *Aphelinoidea*.

When the period of spring emergence of the two parasites was compared with the oviposition period of the overwintered adults of *C. tenellus*, it was found that the two were fairly well synchronised. However, most of the leafhoppers left *Salsola* when the plants began to dry up in autumn, and the populations that were found in beet fields at the time of the spring movement had developed in warmer areas somewhat removed from the summer-breeding areas. At the time of this movement, emergence of the parasites had been completed. Thus, few eggs laid by the overwintered leafhoppers were present in the *Salsola* areas in spring, and the very great numbers of

parasites that developed there were largely unable to reproduce. However, *Salsola* now occurs mostly on overgrazed rangeland together with other wild annual food-plants of the leafhopper, and it is hoped that this will tend to bring the parasites and the leafhopper together in spring, with the result that parasitism may become more effective.

HENDERSON (C. F.). **Parasitization of the Beet Leafhopper in Relation to its Dissemination in southern Idaho.**—*Circ. U.S. Dep. Agric.* no. 968, [1 +] 16 pp., 8 figs., 13 refs. Washington, D.C., 1955.

The following is substantially the author's summary. Studies were made in southern Idaho in 1930–37 to determine the effect of parasitism on the ability of *Circulifer tenellus* (Baker) to migrate long distances and the effect of leafhopper migrations on the dissemination and distribution of its parasites. In southern Idaho, large numbers of *C. tenellus* develop in summer on Russian thistle (*Salsola kali*). In autumn, when the plants become dry or other unfavourable conditions develop, they move to areas in which sagebrush (*Artemisia tridentata*) occurs. Populations develop during the spring on green tansymustard (*Descurainia pinnata*) and other annual plants within the sagebrush areas, and when these plants dry up, the leafhoppers migrate to cultivated fields and Russian-thistle areas, in which they spend the summer. These flights sometimes carry the leafhoppers many miles.

In southern Idaho, the adults are parasitised primarily by Dryinids, Stylopids and Pipunculids (Dorilaids) [*cf. R.A.E.*, A **30** 547]. The first two depend almost entirely on the migration of *Circulifer* for their dissemination, but the Pipunculids are strong fliers, and many undoubtedly fly into the various breeding areas or are carried there by air currents. However, the commonest method of dissemination for this family also is transport as larvae within their leafhopper hosts.

Large numbers of leafhoppers were collected before and after the autumn and spring migrations, to determine the percentages parasitised and to estimate the loss in parasites associated with migration of the hosts from one breeding area to another. Before the autumn migration, 29 per cent. of dissected leafhoppers from the Russian-thistle areas were found to be parasitised, as compared with 19 per cent. of those that reached the overwintering sagebrush area. The parasite larvae were small and did not greatly handicap the leafhoppers in short-distance migrations. Of the parasitised leafhoppers observed at the time of the autumn migration, 98 per cent. were parasitised by Pipunculids, practically all of which were *Tömösváryella vagabunda* (Knab). In the autumn migrations of 1934–37, there was a slight tendency towards decreased parasitism as the distance into the sagebrush area increased. The spring migration of the leafhopper usually occurs during the first half of June. At that time, the Pipunculid larvae vary in size, and the presence of a large larva in the body of the leafhopper affects its ability to fly. In the spring of 1937, there was a significant reduction in the percentage parasitism of the disseminating leafhoppers as the distance into the cultivated areas increased, due to the shorter distances travelled by leafhoppers containing large larvae. There was, in general, a negative correlation between the percentage parasitism and the distance travelled by the host, and where long-distance migrations occur, these reductions may be of great importance. When transferring from one breeding ground to another, the leafhopper often travels 200–300 miles or more. In these long migrations, it is possible that few parasitised spring-generation leafhoppers would reach the new breeding area. Internal parasites of insects that migrate long distances are always at a disadvantage in reducing host populations, and in this case, before the parasites have time to effect much control, the leafhoppers move, with a

consequent decrease in parasites. In recent years most of the Russian thistle has been found on overgrazed rangeland together with other annual weeds, and this should favour the internal parasites [*cf.* also preceding abstract] and reduce the need for leafhopper migrations.

Williams (A. J.). **Biology of the Common Red Spider.**—*J. Kans. ent. Soc.* **27** no. 3 pp. 97–99, 4 refs. Manhattan, Kans., 1954.

Tetranychus telarius (L.) (*bimaculatus* Harvey) is an important pest of cotton and other crops in Arkansas, where outbreaks have occurred with increased frequency since the use of DDT and other organic insecticides became widespread. In view of this, the bionomics of the mite were studied in January–May 1951, rearing being carried out in the greenhouse on potted plants of cotton and *Ageratum*. In general, males and females required the same number of days to complete their development. Though only one nymphal stage had previously been recorded for the males, seven of nine males passed through two, as did all the females. The larval, protonymphal and deutonymphal stages lasted 2–4, 1–5 and 1–3 days, with averages of 2·4, 1·9 and 2·3 days, at temperatures of 67–79°F., 68–80°F. and 70–78°F., respectively, and each comprised an active and a quiescent period. The females required 3–8 days (averaging 6·5) for development from hatching to maturity at a mean temperature of 72–79°F., and the males 5–9 days (averaging 6·8) at 65–83°F., the average temperature being 76°F. Females laid 1–16 eggs daily, with an average of 5·4, and oviposited for 10–36 days, averaging 22·4 at 65–83°F. The maximum number of eggs laid per female was 212, and the average 122, these numbers being considerably higher than the maxima recorded in the literature. The eggs hatched in about three days, and there was a preoviposition period of about one day.

Painter (R. H.) & Schesser (J.). **Western Wheat Grass, an over-summering Host of *Aceria tulipae* (K.), Vector of Streak-mosaic of Wheat.**—*J. Kans. ent. Soc.* **27** no. 3 pp. 118–119, 1 fig., 4 refs. Manhattan, Kans., 1954.

Following a limited outbreak of wheat streak mosaic in north-central Kansas in 1953, a search was made for possible perennial plants on which *Aceria tulipae* (Keifer), the vector of the virus [*cf. R.A.E.*, A **44** 114, etc.], might develop during the part of the summer when growing wheat is not available. As a result, the mite was frequently observed on western wheat grass (*Agropyrum smithii*), which is common along the edges of wheat fields in central and western Kansas, and occurred on it even when it was situated some distance from wheat. All stages were found on the grass, the colonies being most frequent in the whorls of non-fruiting stems. When mites collected from *A. smithii* in several counties were placed on 43 wheat plants in the greenhouse, colonies developed on 12 plants, even though the temperature was well above 100°F. Colonies were also reared on *Agropyrum* from individuals collected or reared on wheat. In a test on air carriage, field-collected stems of *Agropyrum* infested with the mite were placed between an electric fan and a bed of seedling wheat. After the fan had been in operation periodically for several days, colonies of mites and thrips were observed on the wheat, the mites having apparently been transported by the air current [*cf. loc. cit.*]. *Oligonychus* (*Paratetranychus*) *pratensis* (Banks) was found associated with *Aceria* on *Agropyrum*, and it is thought that webs made by the former may assist wind carriage of the latter. Although *A. smithii* is a potential source

of infestation of wheat by *Aceria tulipae*, it appears to be immune from wheat streak mosaic, and a source of the virus for transmission to wheat has still to be found.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **4** no. 11 p. 172. Rome, 1956.

It is reported by the U.S. Department of Agriculture that infestation by *Ceratitis capitata* (Wied.), which was discovered in Florida in April 1956 [*cf. R.A.E.*, A **44** 394], had been found by mid-June in 18 counties in that State, a list of which is given.

B. E. V. Parham states that the occurrence of the bunchy-top disease of bananas has been confirmed in Western Samoa and that *Pentalonia nigronervosa* Coq., the vector of the causal virus, has also been found there. A campaign for the control of the Aphid and the eradication of infected plants was begun. In the South Pacific, both the Aphid and the disease have been recorded from Fiji [*cf.* **36** 413, etc.] and Wallis, the Aphid also from Tonga [*cf.* **40** 206], the Cook Islands and (on one occasion on potted plants) American Samoa, and the disease also from the Ellice Islands.

Dumbleton (L. J.). **A List of Insect Pests recorded in South Pacific Territories.**—*Tech. Pap. S. Pacif. Comm.* no. 79, 196 pp., 7½ pp. refs., multigraph. Noumea, 1954.

The South Pacific Commission is an advisory and consultative body established by agreement between Australia, France, the Netherlands, New Zealand, the United Kingdom and the United States to recommend means of promoting the well-being of peoples of the Island Territories under their administration in the South Pacific region. The area of the Commission's activities comprises not only the territories lying generally south of the equator from Netherlands New Guinea to Pitcairn (but excluding the Kingdom of Tonga), but also Guam and the Trust Territory of the Pacific Islands under United States administration. This list of the insects, mites, nematodes and molluscs that attack crop plants or stored products in the area and in Tonga was compiled in accordance with the recommendations of a conference held in 1951 and is arranged alphabetically, showing the scientific names of the pests, the plants or products attacked, and the territories concerned. It is accompanied by a list of the plants, showing their popular names in English and French and the pests that attack them in the various territories, with references to the literature, and a list of the territories covered.

Dumbleton (L. J.). **Digest of Plant Quarantine Regulations. Second Supplement. South Pacific Commission Area.** – 5 + [20 pp., multigraph. Rome, Fd. Agric. Org. U.N., 1956.

This second supplement to a work already noticed [*cf. R.A.E.*, A **41** 128; **42** 321] contains digests of the regulations governing the importation of plants and plant material into Tonga and 13 territories within the area of the South Pacific Commission [*cf.* preceding abstract]. The latter comprise American and Western Samoa, the British Solomon Islands, Fiji, the Gilbert and Ellice Islands, Nauru, Netherlands New Guinea, New Caledonia, the New Hebrides, Niue Island, Norfolk Island, the Union (Tokelau) Islands and the U.S. Trust Territory of the Pacific Islands.

Biological Control of noxious Weeds. Fiji Contribution.—*Agric. J. Fiji* **25** (1954) no. 3–4 p. 64. Suva [1955].

In the course of this note on work in connection with the biological control of noxious weeds in Fiji, it is reported that the seedfly [*Euaresta aequalis* Lw.] that was introduced from Queensland and released for the control of Noogoora burr [*Xanthium pungens*] [*cf. R.A.E.*, A **44** 249] has not been recovered in the field.

O'Connor (B. A.). **The Rhinoceros Beetle** (*Oryctes rhinoceros* **L.**). **Notes on the Control Campaign in Fiji.**—*Agric. J. Fiji* **25** (1954) no. 3–4 pp. 84–88, 1 map, 2 refs. Suva [1955].

The distribution of *Oryctes rhinoceros* (L.) on coconut in the south-east of Viti Levu [*cf. R.A.E.*, A **44** 269] has continued to increase and a map based on records up to July 1954 is given showing the areas in which breeding is heavy, those in which it is light and those in which damaged palms occur but breeding has not been observed. The detection and destruction of likely breeding places and the use of compost traps continue. The trap now in use consists of a pit 15 ins. square and 24 ins. deep containing a mixture of damp sawdust, 24 lb. coconut meal, ½ lb. 50 per cent. dispersible BHC powder (6·5 per cent. γ isomer) and 4–5 gals. water. The mixture should be poured loosely into the pits, as good aeration appears necessary for rapid decay. The proportion of dry coconut meal to sawdust is approximately 1:2 by volume. To investigate the duration of effectiveness of the BHC, five males and five females were enclosed (with pieces of sugar-cane as food) with material taken from one of the drums used 7½ months previously in the cage experiments [*cf.* **44** 270], consisting of a mixture of 1 lb. 50 per cent. BHC powder (6·5 per cent. γ isomer) per 10 cu. ft. compost mixture. When removed after four days, four males and two females were dead whereas the remainder were living and survived on being transferred to untreated sawdust. The mixture could thus be expected still to inhibit the development of larvae.

As good results against the adults had been obtained elsewhere by placing DDT or BHC in the leaf axils of palms, tests on this method were begun, and BHC was found in preliminary experiments to be more effective and much more rapid in action than DDT. In laboratory tests, adults were confined for two hours on mixtures of 9 parts damp sawdust and 1 part finely ground BHC powder (6·5 per cent. γ BHC), a coarser powder containing 10 per cent. γ BHC, or powdered technical BHC. They were then removed to untreated sawdust, and all were dead in 1–3 days. There was no mortality in the controls. Confinement for two hours on mixtures that had been weathered for a fortnight, including exposure to heavy rain, resulted in 50–75 per cent. mortality in three days. In an outdoor cage test, the coarse BHC powder was mixed 1:9 with damp sawdust and placed in the axils of the youngest four and youngest five fronds of two small palms. At dusk, 11 males and eight females were placed in the cage on a drum containing compost. The beetles attacked the palms in the treated axils, and [illegible] five days, eight males and six females were dead, one male and one female were moribund, one male and one female were alive in the compost, and one male had bored into the palm. Only two of the dead beetles were considered to have died from natural causes. Some of the BHC mixture was recovered after the palms had been exposed to the weather for 4½ months, and beetles confined with it for 2½ hours and then removed to damp sawdust were all dead within five days. Treatment of the crowns of palms inspected in the field has now become routine, the products containing 6·5 or 10 per cent. γ BHC being the most widely used.

In February 1954, a further 2,000 adult Histerids of the genus *Hololepta* (*Lecionota*) were received from Trinidad [*cf.* **44** 270] and released. Small numbers of the predacious Carabid, *Mecodema spinifer* Broun, obtained from New Zealand, were also liberated, and the introduction of further natural enemies was under consideration.

Though populations of *O. rhinoceros* are low in Fiji, several beetles have on occasion been observed boring in a single palm, and it is thought that the fermenting sap in the tunnel made by the first beetle may attract others. Over half the larvae collected have been found in rotting logs, stumps and standing trunks and branches of palms and other trees, most of them in coconut and *Inocarpus edulis*.

O'Connor (B. A.), Pillai (J. S.) & Singh (S. R.). **Notes on the Coconut Stick Insect, *Graeffea crouani* Le Guillou.**—*Agric. J. Fiji* **25** (1954) no. 3–4 pp. 89–92, 1 fig. Suva [1955].

Graeffea crouanii (Le Guillou) is widely distributed on coconut in Fiji, and local outbreaks in Taveuni occasionally cause severe damage [*cf. R.A.E.*, A **40** 210]. In observations on the bionomics of this Phasmid, the egg stage averaged 90 and 100 days at about 79 and 74°F. (representing the warm and the cool season), respectively, and atmospheric and soil humidity appeared to have no effect on embryonic development or hatching. The five nymphal instars of the males and the six of the females were completed in averages of 92 and 111 days, respectively, at 74°F., and the corresponding averages would probably be about 80–85 and 100 at 79°F. There was a preoviposition period of about 20 days, and females laid 106–131 eggs each, with an average of 119. Adult males and females survived for averages of 167 and 115 days, respectively. The females drop their eggs freely from their resting places on the palm fronds. Most of the eggs fall to the ground, and the nymphs can be trapped by adhesive bands as they ascend the trunks. This method does not give complete control, however, as some of the eggs lodge in the axils of the fronds and hatch there. Dusting the palms with BHC was tested under unfavourable conditions of weather and equipment, but a 50 per cent. dispersible powder containing 6·5 per cent. γ isomer, applied at 10 lb. per acre, gave 56 per cent. mortality of the insects, most of those killed being nymphs. A 10 per cent. dust (1·3 per cent. γ isomer) proved ineffective, except on one palm given a massive application, which resulted in almost complete kill.

Parasites reared from eggs of *G. crouanii* collected in Taveuni and Vanua Levu were found to represent undescribed Eupelmids [*cf.* **44** 186]; 87 females and 14 males were reared from nine eggs, one giving rise to females only. In the laboratory, one male and 12 females that emerged on 16th June from a field-collected egg were enclosed with 20 *Graeffea* eggs laid between 13th May and 16th June, honey solution being provided in the tube; oviposition occurred immediately, and all the parasites were dead by 20th June. Six of the eggs were parasitised. Parasite adults emerged from two of them on 15th and 17th August. Of the remaining four eggs, three were dissected on 9th and 12th August and found to contain normal males and females that paired immediately on release. The fourth egg was dissected on 23rd August and contained males only. Since normal parasites were obtained from the eggs dissected before and after the date on which others of the same age emerged naturally, and dead adults have been found in field-collected eggs, it appears that certain conditions as yet unknown may delay or prevent escape. It is likely that populations of *Graeffea* are normally prevented from rising above a low level in Fiji by the parasites and that outbreaks result when conditions are unfavourable for them.

Mulcock (A. P.). **A Disease of Manuka** *Leptospermum scoparium* **Forst.**—*Trans. roy. Soc. N.Z.* **82** pt. 1 pp. 115–118, 1 pl., 6 refs. Wellington, N.Z., 1954.

Hoy (J. M.). **A new Species of** *Eriococcus* **Targ. (Hemiptera, Coccidae) attacking** *Leptospermum* **in New Zealand.**—*T. c.* pt. 2 pp. 465–474, 11 figs., 2 maps, 5 refs. **Manuka Blight: causative Organism.**—*Proc. 6th N.Z. Weed Contr. Conf. 1953* pp. 38–40. Wellington, N.Z. [?1954].

In the second of these papers, descriptions are given of the first-instar nymphs and the adults of both sexes of *Eriococcus orariensis*, sp.n., the mealybug associated with the death of manuka (*Leptospermum scoparium*) in many parts of New Zealand [*cf. R.A.E.*, A **40** 28–29]. Maps are given showing the known distribution of the insect on both Islands, but as dissemination of infested plant material is continuing, despite recommendations to the contrary, it is probably well established in almost all areas in which manuka is considered a hindrance to farming.

Observations on the bionomics of *E. orariensis* in the Canterbury area showed that there is apparently only one generation a year. Eggs were laid within the sac of the female, and some of the parent females died before oviposition was complete. The nymphs were at first quiescent, but then became very active. Spread between plants in a dense stand occurred through contact of branches, wind movement of bushes and movement of the nymphs along the ground. The latter were carried for greater distances by wind. Nymphs were present from March to September, and maximum numbers were active in the second half of April and in May. The males pupated in September, the cocoons being found mainly on the leaves and lower stems on the sooty mould that develops on the copious honeydew excreted. Large numbers of males were present and paired with the females in October–January; most of the females were dead by February.

The possible origin of the mealybug is briefly discussed. It can be controlled by spraying with a mixture of eight parts 50 per cent. wettable p,p′DDT or 10 per cent. wettable γ BHC, one part nicotine sulphate and eight parts wetting agent in 800 parts water, but the treatment is costly and is recommended only for ornamental trees.

The third paper comprises a shorter and more popular account of the information contained in the second, but does not include a description of the mealybug. The first paper contains an account of investigations showing that the sooty mould that develops on the honeydew produced by the mealybug is probably *Capnodium walteri*, a fungus not previously recorded from New Zealand, and that its occurrence on the leaves leads to a reduction of photosynthesis. Little damage is caused for the first few months, but the whole plant later becomes covered with a black felt of mycelium, only a few leaves at the tips remaining unaffected. The fungus persists on the dead trees until the bark flakes off. The effect was experimentally produced on plants not infested with the mealybug by spraying them with a 1 per cent. solution of honey at regular intervals after treatment with a suspension of hyphal fragments from a laboratory culture of the fungus.

Barnes (H. F.) & Nijveldt (W.). **A new Gall Midge,** *Coccomyza leefmansi* **sp.n., predaceous on the Eggs of** *Paivinaria polygonata* **in Indonesia.**—*Ent. Ber.* **16** no. 4 pp. 91–96, 14 figs., 3 refs. Amsterdam, 1954.

Descriptions are given by Nijveldt of the adults of both sexes of *Coccomyza leefmansi*, sp.n., the larvae of which were observed preying on the eggs of

Pulvinaria polygonata Ckll. on *Citrus* at Bogor, Java, in October 1952. The systematic position of the Cecidomyiid is discussed.

DE FLUITER (H. J.). **Phaenologische waarnemingen betreffende de aardbeiknotshaarluis,** *Pentatrichopus fragaefolii* **Cock., in Nederland.** [Observations on the Phenology of the Strawberry Aphid, *Capitophorus fragaefolii* in Holland.]—*Ent. Ber.* **15** no. 4 pp. 94–98, 1 graph, 4 refs. Amsterdam, 1954. (With a Summary in English.)

The following is based on the author's summary. Sampling in selected fields in the strawberry-growing areas of Holland in 1948–53 showed that two distinct rhythms exist in the annual cycle of *Capitophorus* (*Pentatrichopus*) *fragaefolii* (Ckll.) [*cf. R.A.E.*, A **41** 40], depending on climatic conditions between autumn and early summer. After a severe winter and unfavourable weather in spring and early summer, the population in all plantings (whatever their age) rose to a low peak in autumn and then declined with the onset of frost. This occurred in 1950, 1951 and 1953. After a mild winter, or when conditions were favourable in spring and early summer, it rose to a high peak in late June or early July. This peak was followed by a rapid decline, and low populations persisted in August and early September; there was a further increase with favourable weather in late September and October, as was observed in 1948, 1949 and 1953. Considerable numbers of alates occurred in May, June and July and also in late autumn. The two periods of increase of the Aphid population coincide with the two periods in which strawberry plants produce young leaves in abundance. The critical periods for the Aphid are July and early August, when there is a reduction in the number of young leaves produced, and February–March, when very few leaves are suitable for Aphid development.

FRANSSEN (C. J. H.). **Biologische bestrijding van de sabelsprinkhaan** *Scxava nubila* **St. op de Talaude-eilanden.** [The Biological Control of *S. nubila* in the Talaud Islands.]—*Ent. Ber.* **15** no. 4 pp. 99–102, 2 refs. Amsterdam, 1954. (With a Summary in English.)

In 1948–50, the author investigated the effectiveness of the introduced Encyrtid egg-parasite, *Leefmansia bicolor* Wtstn. in controlling *Sexava nubila* (Stål) on coconut in the Talaud Islands (Indonesia) [*cf. R.A.E.*, A **16** 130], where no other parasite of the Tettigoniid occurs. Though the majority of the eggs of *S. nubila* are laid in the ground [**16** 129], parasitism was considerably higher among those laid on vegetation, the maximum percentages observed in 1949 being about 30 and 95, respectively, with averages of 20 and 90. In order to increase the effectiveness of biological control, wild food-plants of *S. nubila* should be removed from the groves and other vegetation encouraged, as *S. nubila* does not oviposit in soil with a dense plant cover. In the second half of 1949, wild plants were cleared from three plantations on the island of Salebaboe, clove and cacao trees planted beneath the coconuts, and a mixture of *Centrosema pubescens* and other green manure plants sown to give groundcover. In April 1950, the palms showed only slight damage by *S. nubila*, the eggs of the latter were found to have been laid exclusively on the vegetation, where 85–95 per cent. of them were parasitised, and the cacao and clove trees were in good condition. The groundcover consisted entirely of *Centrosema*, which had grown to a height of about 16 ins.

Betrem (J. G.). **De invloed van de relatieve luchtvochtigheid op de ontwikkeling van** *Helopeltis antonii* **Sign. (Hem. Het.).** [The Influence of relative Humidity on the Development of *H. antonii*.]—*Ent. Ber.* **15** no. 4 pp. 106–112, 1 fig., 9 refs. Amsterdam, 1954. (With a Summary in English.)

Since atmospheric humidity and evaporation rate have been reported to affect the development of *Helopeltis antonii* Sign. in Java [*cf. R.A.E.*, A **4** 443; **5** 132; **19** 646], tests were carried out in 1939–40 in which the bugs were reared at a room temperature of about 26°C. [78·8°F.] and a relative humidity of 73·5 or 100 per cent. on pieces of cacao pods in direct contact with water, a current of air of the required humidity being passed over them. It was found in 1939 that development from hatching to the adult stage averaged 12·75 and 12·125 days for the males and 12·95 and 12·45 days for the females at the two humidities, respectively, and the difference, though small, was significant for the males. The percentages of both sexes that died in the nymphal stage at 73·5 and (in brackets) 100 per cent. humidity were 23·4 (30·2) in 1939 and 44·1 (42·1) in 1940, and the percentages of females that oviposited were 45 (40) and 100 (80), respectively, the numbers of eggs laid per female averaging 89·9 (78·3) and 298·9 (74·4); the high average egg-production at 73·5 per cent. relative humidity in 1940 was due to two exceptionally long-lived females. Of the bugs that hatched from the eggs, 10·5 (12·1) and 44·1 (33·6) per cent. oviposited, laying averages of 3·7 (5·1) and 6·2 (2·6) eggs each daily. The higher rate of mortality of the nymphs in 1940 may have been due to an alteration in the composition of the sap [*cf.* **23** 402] resulting from the dry conditions obtaining in that year. In a test, the percentages of nymphs that died between May and October 1940 tended to vary inversely with the water content of the cacao pods, and this is probably of more significance than relative humidity.

Kalshoven (L. G. E.). **Dermestids in Indonesia. 4. On the Development of** *Dermestes* **Species on dried Fish and Meat in Java.**—*Ent. Ber.* **15** no. 4 pp. 112–116, 1 fig., 6 refs. Amsterdam, 1954. **5. Note on** *Orphinus fulvipes* **Guér.**—*Idea* **10** no. 3 pp. 50–53, 1 fig., 6 refs. Bogor, 1955.

In the first of these two parts of a series [*cf. R.A.E.*, A **24** 243; **25** 598], it is stated that *Dermestes* spp. caused considerable damage to dried fish in Java after 1939, up to 70 per cent. of the stocks being destroyed. Unsalted fish was more severely infested than slightly salted fish, dried shrimps or sugared seasoned meat, and strongly salted fish was not usually attacked. The commonest species concerned were *D. maculatus* Deg. and *D. ater* Deg., and they were reared in the laboratory at Bogor in 1942–43. On dried meat, females of the two species laid averages of 414 and 226 eggs each and survived for averages of 97 and 55 days, respectively. The males survived for averages of 142 and 88 days. The larvae of *D. maculatus* consumed 0·5–0·9 gm. dried meat or fish each in the course of their development. On unsalted dried meat, the larval stage of *D. maculatus* lasted 21–26 days, and on unsalted dried fish, that of *D. ater* lasted 28–56 days, these materials permitting the most rapid development. The minimum time required for development from egg to egg was 35 days at Bogor and is probably less in the hot coastal plains.

In the second part, further information is given on the feeding habits in Java of *Orphinus fulvipes* (Guér.), of which Hinton has found *O. aethiops* Arr. to be a synonym [*cf.* **25** 532; **26** 434]. In addition to attacking tobacco seed and book bindings, the Dermestid was also found in cavities made in

wood by termites, in green cheese and on dried shrimps and entomological specimens. The egg stage lasted 10–11 days, and when the larvae were provided with dried termite specimens, which were the preferred food, the larval and pupal stages together lasted 10 months. Development was slower when the larvae fed on flour and tobacco seed in addition to the termites.

VAN DER VECHT (J.). **Parasitism in an Outbreak of the Coconut Moth (*Artona catoxantha* (Hamps.)) in Java (Lep.).**—*Ent. Ber.* **15** no. 4 pp. 122–132, 2 figs., 5 refs. Amsterdam, 1954.

The following is based on the author's summary. The relations between *Artona catoxantha* (Hmps.) and some of its primary and secondary parasites on coconut [*cf. R.A.E.*, A **39** 218] were studied during an outbreak of this Zygaenid near Djakarta, West Java, in 1939–40. No control measures were applied. In the groves first attacked, the Zygaenid disappeared within a few generations; in the following months, a few secondary outbreaks developed in neighbouring plantations, but none reached serious proportions. The decrease in the population of *Artona* was accompanied by increasing parasitism of the larvae by *Neoplectrus bicarinatus* Ferrière (which was, however, itself considerably parasitised by *Pleurotropis detrimentosus* Gah.), and the Tachinids, *Ptychomyia remota* Aldr. and *Cadurcia leefmansi* Baranov. *Apanteles artonae* Rohw., which also parasitises the larvae, was unable to increase in numbers, since the generations of the host are sharply distinct [*cf.* **37** 141] and secondary parasites were active. The total percentage parasitism of *Artona* reached a maximum of 67 in the third observed generation, the population of the moth having reached its maximum in the preceding generation. Though the parasites were of considerable importance, it is thought that the termination of the outbreak must to some extent be ascribed to a decline in the physiological condition of succeeding generations [*cf.* also **35** 236], as indicated by the gradual increase in the time required for the completion of successive generations (36, 37, 42 and 44 days), a marked decrease in the reproductive capacity of the females, and a reduction in the ratio of females to males.

TANAKA (M.). **The Settlement of the Red Scale and the Horned Wax Scale on the Potato Tubers. I. The Study of Mass Production of the important Hymenopterous Parasite (*Anicetus ceroplastis* Ishii).** [*In Japanese.*]—*Bull. Kyushu agric. Exp. Sta.* **2** no. 1 pp. 55–63, 9 figs., 7 refs. Hainuzukamachi, Fukuoka, 1953. (With a Summary in English.)

With a view to the mass production of *Anicetus ceroplastis* Ishii for the control of *Ceroplastes rubens* Mask. in Japan [*cf. R.A.E.*, A **44** 354], methods were investigated for propagating its hosts, *C. rubens* and *C. ceriferus* (And.), on potato tubers in the laboratory. When crawlers of both species were placed on the tubers and kept in the dark, they settled only near the eyes, and attempts to hasten sprouting of the tubers by fumigation methods, in order to create a more attractive environment, were unsuccessful. Examination of stained transverse sections of potato tubers and of the mid-ribs of leaves showed that the stylets of the Coccids penetrated to the phloem, and, in a further test, the crawlers settled more readily on the cut surfaces of potato tubers, where the vascular bundles were available, than on other surfaces. It is therefore suggested that mass production of the Coccids could be promoted by removing the skin and outer and inner corticular layers, so as to expose the vascular bundles. *C. ceriferus* appeared to be more readily propagated than *C. rubens*.

Li (Ching-sing). **A preliminary Study with Stored Rice Insect Pests and their Control in Taiwan.**—*Mem. Coll. Agric. Taiwan Univ.* **2** no. 5 pp. 99–103, 13 refs. Taipei, 1953. (With a Summary in Chinese.)

Rice is the most important agricultural product in Formosa, but attack by insects results in a loss of more than 5 per cent. of the stored crop. Examination of granaries and mills in four districts showed that *Rhizopertha dominica* (F.), *Calandra* (*Sitophilus*) *oryzae* (L.) and *Tribolium castaneum* (Hbst.) (*ferrugineum* (F.)) were the most important pests of both unhusked and milled rice. *Alphitobius diaperinus* (Panz.), *Palorus* (*Caenocorse*) *ratzeburgi* (Wissm.), *Sitotroga cerealella* (Ol.), and *Tenebroides mauritanicus* (L.) were next in importance in milled rice, and *Carpophilus dimidiatus* (F.), *Calandra sasakii* Tak., *Cryptolestes* (*Laemophloeus*) *minutus* (Ol.), *Oryzaephilus surinamensis* (L.) and *Tribolium confusum* Duv. least numerous; *C. minutus* and *A. diaperinus* were also found in husked rice.

Investigations were carried out on the control of *Calandra oryzae* and *T. castaneum* by means of impregnated dusts containing 5 per cent. DDT, 5 per cent. γ BHC or 1·5 per cent. rotenone, these being mixed with unhusked rice at the rate of 25, 50, 100 or 250 mg. per 400 gm. and the grain exposed to infestation by 100 adults of *Tribolium* and 30 of *Calandra* for five weeks. The results showed that BHC was more rapid in action than DDT or rotenone and that BHC and DDT gave much higher kills than rotenone. *Tribolium* appeared to be more susceptible to insecticides than *Calandra*, but BHC gave complete kill of both in one week at 100 mg. and very high mortality in two weeks at 50 mg.

Chandy Kurian. **Descriptions of five new and Records and Redescriptions of two known Bethyloidea (parasitic Hymenoptera) from India.**—*Agra Univ. J. Res.* (Sci.) **3** pt. 2 pp. 417–439, 45 figs. Agra, 1954.

The new species described include *Odontopyris argyriae*, sp.n., from a female reared from the sugar-cane borer, *Chilotraea infuscatella* (Sn.) (*Argyria sticticraspis* (Hmps.)), in India.

Gupta (V. K.). **On a new Species of** *Chelonus* **(Braconidae: parasitic Hymenoptera) from India.**—*Agra Univ. J. Res.* (Sci.) **4** pt. 1 pp. 209–211, 3 figs., 2 refs. Agra, 1955.

Descriptions are given of the adults of both sexes of *Chelonus heliopae*, sp.n., which was found parasitising larvae of *Gnorimoschema heliopa* (Lower) on tobacco in India.

Appanna (M.) & Maheswariah (B. M.). **The Grape Flea Beetle,** *Scelodonta strigicollis* **Mots. and its Control.**—*Mysore agric. J.* **30** no. 2 pp. 107–111. 5 figs., 7 refs. Bangalore, 1954.

Grape vines, which are being increasingly grown in Mysore, are attacked there by the Eumolpid, *Scelodonta strigicollis* (Motsch.) [*cf. R.A.E.*, A **10** 41], the bionomics and control of which are briefly reviewed from the literature. The eggs are laid under the bark and in crevices on the vines and hatch in about a week. The larvae feed on the cortical layer of the roots, without causing severe damage, and pupate in earthen cells. The adults appear in large numbers about the time of the pruning seasons (April–May and October–November) and feed on the leaves, buds and tendrils, sometimes killing the vines. In tests on control, good results were given by

a dust prepared from a 50 per cent. DDT product and one containing 0·65 per cent. γ BHC mixed in the proportion of 1 : 4 and applied to the pruned plants at the time of adult emergence.

Batra (H. N.). **Biology and Control of** *Dacus diversus* **Coquillett and** *Carpomyia vesuviana* **Costa and important Notes on other Fruit Flies in India.**—*Indian J. agric. Sci.* **23** (1953) pt. 2 pp. 87–112, 4 col. pls., 14 refs. Calcutta, 1954.

The Trypetids of most importance in India are *Dacus diversus* Coq., *Carpomyia vesuviana* Costa, *D. dorsalis* Hend. (*ferrugineus* (F.)), *D. zonatus* (Saund.), *D. cucurbitae* Coq. and *D. ciliatus* Lw. All stages and the distribution of the first two are described, and an account is given of observations on their bionomics near Delhi, about which little was previously known.

D. diversus has been recorded from various fruits [*cf. R.A.E.*, A **5** 3], but the author found it breeding only in the flowers of cucurbits [*cf.* **4** 66], including white gourd (*Lagenaria vulgaris*) and sponge gourd (*Luffa cylindrica*), which were preferred, and *Coccinia indica*. The larvae fed on the pollen and anthers in the buds and fermentation then set in, causing the buds or half-opened flowers to droop and die. An excess of moisture due to extensive rotting killed the larvae. The adults fed on the honeydew excreted by *Aphis gossypii* Glov., but were often deterred by the presence of the ant, *Camponotus compressus* (F.), which also feeds on the honeydew. The preoviposition period lasted about 18 days in August–September. The eggs were laid in the buds, but captive females also oviposited in the bud-like tender fruits of brinjal [*Solanum melongena*]. No eggs were laid in the fruits of cucurbits or in those of mango or guava. The eggs hatched in 1–4 days in July, and the larval stage lasted 4–5 days in September, up to five larvae being observed per bud. Pupation occurred 1–3 ins. below the surface of the soil, and the pupal stage lasted 8 days in August, 7–8 in September–October and 11–13 in November. Adult males and females survived for 26 and 23 days, respectively, in September when soaked raisins, mango pulp or cut *Luffa* fruits were provided, and their death was probably due to unfavourable weather conditions, as they normally overwinter, surviving in sheltered sites in orchards.

Carpomyia vesuviana attacks the fruits of cultivated ber (*Zizyphus jujuba*) and wild ber (*Z. nummularia*) [*cf.* **11** 439], and its distribution corresponds to that of these plants. Soft, sweet, early varieties of *Z. jujuba* are preferred, up to 80 per cent. of the fruits being damaged. *Z. nummularia* is less severely attacked, since the fruits are less pulpy and are sour when unripe. The eggs are laid in the fruits, one field-collected female laying 49 in 29 days after a preoviposition period of 16 days and surviving for a further 25 days in the laboratory. The eggs hatched in 3–4 days in March and one day in April, and the larval stage lasted 9–12 days in March–April and 22 in November–December, though development in the laboratory was somewhat retarded as the fruits provided dried up rapidly. The prepupal stage lasted 6–12 hours in April and 24 hours in December. When placed on soil, most of the larvae pupated in the top 3 ins., though some were found at a depth of 6 ins. Observations on the pupae showed that some 17 per cent. gave rise to adults after 11–31 days in March–April or 45–87 days in winter, 54 per cent. entered diapause, giving rise to adults only after 116–287 days, and the rest died. Emergence of adults from short-cycle pupae was observed even in May, when the temperature was high, host fruits scarce and chances of breeding very slight. The difficulties of rearing the fly in the laboratory, particularly the provision of suitable food for the adults, are pointed out.

In the field, the fly is active in autumn and spring, passing the hot summer and cold winter months in the pupal stage. Near Delhi there are three emergences of adults. The first occurs between July–August and October–November, maximum numbers appearing in September, when *Z. jujuba* is in flower, and oviposition begins in October, when the fruits first become available. The second occurs between late January and mid-March, and the third in April, but fruits are no longer available when adults that emerge in the latter month become sexually mature and so they die without reproducing. In other parts of India, they may be able to oviposit, as the seasonal development of the host fruits varies. Eggs did not survive in fruits kept at 33°C. [91·4°F.], but the larvae completed their development in them, and pupae kept at the same temperature gave rise to adults at relative humidities of 20–85 per cent., the higher humidities being the most favourable. It was noted that in the year in which emergence of adults from pupae that had been in diapause began the earliest (about 20th July), the temperature in the first half of July had been about 80–95°F., the rainfall heavy and the relative humidity 70–90 per cent. Such early emergence causes the adults to die without ovipositing, as no fruits are available, and small populations can be forecast for the succeeding season.

The larvae were parasitised by *Bracon fletcheri* Silv. and an unidentified Chalcidoid, and the pupae by *Opius carpomyiae* (Silv.) and another Braconid [*cf.* **11** 439], but the combined parasitism was not sufficient to afford control. The measures recommended for this purpose are the destruction of all infested fruits, soil cultivation round the trees in May–June to expose the pupae, spraying the trees after mid-October with 0·1 per cent. chlordane or BHC to kill the adults before oviposition [*cf.* **42** 417], and the use of poison baits from mid-February to mid-March to kill the adults. In tests, neither citronella oil nor Clensel proved attractive to the latter.

D. dorsalis, which has not previously been recorded from *Z. jujuba*, was found infesting the fruits of this plant near Delhi in April. Other fruits were infested later in the year, particularly guava, but *Citrus* was not attacked. In orchard tests, Clensel proved attractive to the males only. *D. zonatus* is commonly found with *D. dorsalis*, though the latter is more numerous and appears to be displacing it in some localities. *D. cucurbitae* is normally restricted to cucurbits, but it breeds in various fruits when cucurbits are scarce and during hot dry weather in May, June and September. *D. ciliatus*, which also attacks cucurbits, is active during these months and is frequently found together with *D. cucurbitae*, both species completing their development even in the same fruit. Considerable control of *D. cucurbitae* is given in July–October by *B. fletcheri*.

SHARMA (B. K.). **Notes on** *Cassida circumdata* **Hbst.,** *Cassida indicola* **Duv. and** *Glyphocassis trilineata* **Hope (Coleoptera: Chrysomelidae: Cassidinae) as Pests of Sweet Potato** (*Ipomoea batatas*) **at Kanpur.**—*Indian J. agric. Sci.* **24** pt. 3 pp. 261–263, 12 refs. Delhi, 1954.

Metriona (*Cassida*) *circumdata* (Hbst.), *Cassida indicola* (Duv.) and *Glyphocassis trilineata* (Hope) were observed at Kanpur [Cawnpore] attacking sweet potato, from which they have not previously been recorded, and on occasion causing considerable damage to the crop. Brief descriptions are given of all stages of the first two and of the adult of the third, together with notes on their bionomics, as observed in 1951–52. *M. circumdata* was present from early August to late November, and both the larvae and adults fed on the leaves, those badly affected drying up. The eggs were laid singly, usually on the lower surface of the leaf, and hatched in 3–5 days. The larval

stage lasted 10–15 days, and the pupal stage, which is passed on the lower surface of the leaves, 6–8 days. *C. indicola*, the habits of which were similar, appeared somewhat later and was less numerous. The egg, larval and pupal stages lasted 3–4, 8–14 and 4–7 days, respectively. *Glyphocassis* was the least common and was taken fairly late in the season.

GOPALAKRISHNAN (R.), UTTAMAN (P.) & BALASUBRAMANIAM (C.) **Influence of Weather on the Incidence of Paddy Gall-fly** (*Pachydiplosis oryzae*) **at Pattambi (South Malabar).**—*Indian J. agric. Sci.* **24** (1954) pt. 4 pp. 343–346. Delhi, 1955.

Pachydiplosis oryzae (Wood-Mason), which infests rice and causes the condition known as silver shoot [*cf. R.A.E.*, A 30 612] is generally of minor importance in Malabar, but causes considerable damage in some years, affecting mainly the first crop (April-May to September-October). Transplanted rice is more severely attacked than broadcast rice and damage occurs also in the nurseries. The incidence of the Cecidomyiid was studied in 1950–52 on two varieties sown in nurseries in the last week of May or the first week of June and transplanted in experimental plots in early July. The maximum percentage of shoots attacked (1·3–1·7, 7·4–8·4, and 13·9–15·6 in the three years, respectively) was observed in the first week of September and coincided with maximum tillering of the plants, after which infestation virtually ceased. Since symptoms were first observed on the plants in early July, oviposition must have begun in the nurseries. In both 1951 and 1952, when the attack was severe, the last half of June was cloudy and wet, favouring oviposition, and the first half of July was bright and warm, favouring hatching. In 1950, the last half of June was bright and the first half of July cloudy and wet.

DUTT (N.). *Nupserha bicolor* **Thoms., subsp.** *postbrunnea* **Breun.: a new Pest on Jute** (*Corchorus olitorius* **Linn.**).—*Nature* **170** no. 4320 pp. 287–288, 1 ref. London, 1952. **Diapause in** *Nupserha bicolor* **Thoms. ssp.** *postbrunnea* **Breun. and its Bearing on Infestation and Control.**—*Jute Bull.* **17** no. 9 pp. 286–287, 3 figs., 1 ref. Calcutta, 1954. **Studies on** *Nupserha bicolor* **Thoms. ssp.** *postbrunnea* **Breun. (Col., Lamiidae). Preliminary Observations on immature Stages and Elimination of larval Diapause.**—*Op. cit.* **18** no. 10 pp. 254–256, 8 figs., 8 refs. 1956.

In the first paper, the author reports that the Lamiid, *Nupserha bicolor postbrunnea* Breun., which had not previously been recorded from India, was found attacking all varieties of *Corchorus olitorius* at Barrackpore in West Bengal in 1949. The female cuts two rings 0·7–2·7 cm. apart round the stem of the jute plant and a slit penetrating to the pith tissue between them, in which oviposition occurs. This causes the apical part of the stem to wither and die. Oviposition was found almost exclusively at sites where the diameter of the stems was 0·2–0·4 cm., and as damage is restricted to the upper parts, the loss is insignificant on older plants. Loss of stems on young and older crops are estimated at about 30 and 6 per cent. respectively. *C. capsularis* was less attacked.

In the second paper, it is stated that infestation of *C. olitorius* at Barrackpore increased rapidly, about 14 per cent. of the plants being attacked in 1954. The larvae feed in the stems, and those that are in the last instar at the end of the jute season, in November, enter diapause. Before doing this, the larva cuts the stem just above and below itself and plugs the ends

of the central portion with frass, so as to form a chamber. The cut portions, which are 1–6 ins. in length, fall to the ground, and the larvae remain dormant in them, so that they are not affected when the jute is submerged for retting after harvest. In the laboratory, dormancy persisted for over 18 months, and the larvae died without giving rise to adults. Survival was not reduced when dormant larvae were kept under the soil with or without their cases. The adults proved susceptible to DDT and BHC in the laboratory, but would be difficult to control in the field as they are seldom seen and attack the plants only at certain heights. *C. capsularis* might be cultivated in preference to *C. olitorius* where suitable land is available, but the chief control measure recommended is the collection and destruction of the pieces of stem in which the larvae pass the diapause.

In the third paper, it is stated that the feeding by the larvae, which is confined to the shrunken pith tissue, does not affect the growth of the plant or damage the fibre layer. It was found that the larvae could develop in all varieties of *C. capsularis*, though this species is resistant to attack by the adults, even those derived from larvae reared on it. The larval stage lasted 30–50 days during the jute season. Mortality among larvae that were observed from the beginning of diapause (November 1953) began in the second month and reached a maximum between the 16th and 20th months. After 660 days, about 93 per cent. of the larvae were dead and no adults had been obtained. A high relative humidity was necessary for elimination of the diapause, and 14 of 20 larvae that had remained dormant for eight months gave rise to adults within three months when kept at 30°C. [86°F.] and a relative humidity of 97 per cent. Only four of 20 gave rise to adults at 85 per cent. relative humidity. Emergence in the field is shown to be preceded by rain, and to be delayed when this is late.

Beardsley jr. (J. W.). **Fluted Scales and their Biological Control in United States Administered Micronesia.**—*Proc. Hawaii. ent. Soc.* **15** no. 3 pp. 391–399, 20 refs. Honolulu, 1955.

This review of *Icerya* spp. and their natural enemies in the islands of Micronesia administered by the United States is based on observations in the Caroline and Marshall Islands in 1952–54 and the scattered records available for the area. The main crop affected is breadfruit (*Artocarpus communis* (*incisus*)), which is the staple food of the inhabitants. The scales congregate usually on the lower surfaces of the leaves along the midrib and large veins but sometimes on the developing fruits, and cause defoliation, reductions in crop and sometimes even the death of the trees. They also attack other crops, notably *Citrus*, and long dry periods apparently favour the development of heavy infestations. *I. aegyptiaca* (Dgl.) is the predominant species and the commonest on breadfruit; it sometimes damages *Citrus* and has also been found on banana, taro (*Colocasia esculenta* and *Alocasia macrorrhiza*), *Pandanus* and young coconut palms, and several of its wild food-plants are widely distributed in the islands. It was not reported there before 1936, but was probably present several years earlier, and is usually attacked by *Rodolia*. The islands on which it has been found since 1946 are listed. *I. seychellarum* (Westw.) has been known to occur on a few islands in western Micronesia since 1936, and on one in which it was present on breadfruit in company with *I. aegyptiaca*, it was the more serious pest; no attack by *Rodolia* was seen. *I. purchasi* Mask. was a serious pest of *Citrus* on Guam until controlled by *R. cardinalis* (Muls.), but has not been recorded on breadfruit. It is apparently absent from the other islands [*cf. R.A.E.*, A **28** 266], and records from them [*cf.* **23** 611] probably refer to *I. aegyptiaca*. The closely related *Steatococcus samaraius* Morr. infests banana, coconut and other

plants in the Palau Islands but is only a minor pest, being apparently controlled by natural enemies.

The scales are attacked on various islands by species of *Chrysopa*, *Coccinella* (*Harmonia*) *arcuata* F., *Coelophora inaequalis* (F.), *Cryptolaemus montrouzieri* Muls. and *Scymnus* sp., and entomogenous fungi, but only introduced species of *Rodolia* afford economic control. *R. cardinalis* has been established on Guam since 1926, *R. pumila* Weise has been liberated on several islands since 1947 and was probably the species distributed by Japanese workers in 1928 under the name *R. cardinalis*, but has become established in only a few places, and a species tentatively identified as *R. fumida* Muls. was introduced from India and released on Guam and islands of the Majuro Atoll in 1948 and may have become established in the latter. A record of *R. koebelei* (Olliff) controlling *I. aegyptiaca* in Micronesia [**28** 266] is considered to refer to *R. pumila*.

Hoyt (C. P.). **Notes on Larvaevorid Flies reared from** *Prodenia litura* **Fab. and** *Othreis fullonia* **(Clerck) Larvae in American Samoa.**—*Proc. Hawaii. ent. Soc.* **15** no. 3 pp. 419–421. Honolulu, 1955.

Larvae of *Prodenia litura* (F.) causing severe damage to taro [*Colocasia esculenta*] in American Samoa were found on 2nd February 1954 to be attacked by Tachinids, 90 per cent. of the full-grown larvae being parasitised. Examples collected from another heavily infested planting on 5th February comprised 14 and 21 unparasitised larvae in the third and fourth instars, respectively, and 26 parasitised larvae in the fourth instar, with an average of 3–5 eggs attached to each. A few parasitised third-instar larvae were found on 17th–18th February, when parasitism of fourth-instar individuals had fallen to 6 per cent. The caterpillars destroyed most of the taro in February, but were controlled by dusting with 5 per cent. DDT or methoxy-DDT (methoxychlor). The Tachinids were identified as *Sturmia aequalis* Mall. and *Winthemia* sp., possibly *W. dispar* (Macq.). Although *P. litura* was readily parasitised by both species, it was evidently not an adequate host for *Winthemia*, as adults reared from it were unusually small. All the *Sturmia* larvae left the host before it pupated, whereas those of *Winthemia* left after it had formed a cocoon. *Sturmia* spent about eight days as egg and larva in the host and 8–9 days in the puparium, and the corresponding periods for *Winthemia* were each 12 days. One adult of either parasite usually developed from a single host when this bore 3–12 eggs, but three *Prodenia* larvae bearing 2–3 eggs each all developed into normal moths. When *Winthemia* was reared for comparison on larvae of *Othreis fullonia* (Cl.) collected from *Erythrina*, the parasite spent about ten days as egg and larva in the host and nine days in the puparium, and 12 adults developed from four host larvae bearing 5–8 eggs each, whereas two larvae bearing four eggs each gave rise to normal moths.

Marucci (P. E.). **Notes on the predatory Habits and Life Cycle of two Hawaiian Earwigs.**—*Proc. Hawaii. ent. Soc.* **15** no. 3 pp. 565–569, 2 refs. Honolulu, 1955.

As *Anisolabis eteronoma* Borelli and *Sphingolabis hawaiiensis* (Bormans) were frequently observed feeding on larvae of *Dacus dorsalis* Hend. in rotting guava fruits and in the soil in Hawaii, their habits and life-history were studied in the laboratory. Newly hatched nymphs of *Anisolabis* kept with guava fruits that were uninfested or infested only with *Drosophila* larvae developed more slowly after three weeks than those kept with guavas

containing half-grown *Dacus* larvae, and attacked one another. Predacious mites from the *Drosophila* larvae attacked and apparently weakened the earwigs, and none of the latter reached the adult stage in their presence. All nymphs provided with *Dacus* larvae and two of five provided only with guava gave rise to adults, the development periods being 95 and 123 days, respectively. The nymphs each consumed about one larva in two days, and the gravid females two per day; adults provided with guava fruit but no *Dacus* larvae, fed on their own eggs. Adults of *Sphingolabis* each consumed one larva per day and produced more young when *Dacus* larvae were present than when they were kept with guava only, but did not feed on their own young. When the larvae were numerous, both species killed many more than they consumed; dead and living larvae seemed to be equally acceptable to both, but the pupae were often untouched, even in the absence of other insect food. *S. hawaiiensis* reproduced viviparously, apparently 30–40 days after mating, the greatest number of nymphs produced by a single female being 37 over a period of 72 days. *A. eteronoma* laid eggs in four groups in chambers in the soil; one adult laid 158 viable eggs in large groups over a period of 46 days, and the egg stage lasted 12–14 days. The nymphal stage of *Sphingolabis* averaged about 47 days, and adults of this species and of *Anisolabis* lived for up to 91 and 116 days, respectively, in the laboratory.

Steiner (L. F.). **Fruit Fly Control with Bait Sprays in Relation to Passion Fruit Production.**—*Proc. Hawaii. ent. Soc.* **15** no. 3 pp. 601–607, 3 refs. Honolulu, 1955.

Dacus dorsalis Hend. is a serious threat to the commercial production of passion fruit (*Passiflora edulis* var. *flavicarpa*) in Hawaii, since the crop is grown on newly cleared land in areas abounding in wild guava, in which the fruit-fly is generally abundant. In some localities, infestation by *Dacus cucurbitae* Coq. is also important. The passion fruit emerges from the remains of the flower in 3–5 days and reaches full growth in 10–15 days, and the fruit-flies are attracted to it and readily oviposit in it during the growing period, though the larvae rarely mature unless it falls and rots; most die in the first instar. The full-grown fruit ripens in 50–70 days, during which time it is less susceptible to attack or injury, but it becomes very attractive to the ovipositing females when ripe, and the larvae readily mature in such fruits. The local custom of allowing the ripe fruits to drop and remain on the ground for several days before collection may lead to an influx of fruit-flies from neighbouring plants; most of those that oviposit in commercially grown passion fruits are immigrants, since the ripe fruits are generally removed before the larvae in them reach maturity.

Bait-sprays containing 1–4 lb. 25 per cent. wettable malathion and 0·5–2 lb. enzymatic yeast hydrolysate or partially hydrolysed yeast protein in 6–150 U.S. gals. water per acre, applied at intervals of 1–3 weeks, have been successfully used on various fruits in Hawaii [*cf. R.A.E.*, A **41** 143], being equally attractive to newly emerged and gravid females and more so than to the males; *D. dorsalis* and *D. cucurbitae* responded equally to them. The sprays are relatively innocuous to parasites, and also to pollinating insects unless applied to them directly, and are most effective when applied to the foliage, so that they are less likely than other sprays to leave injurious residues on the fruits at harvest. They should be applied to the plants after any other spray required and before noon, when the blooms begin to open and attract pollinating insects.

Experiments in which bait-sprays of 2–4 lb. 25 per cent. malathion, 1–2 lb. partially hydrolysed yeast protein and varying amounts of water were

applied to the vines 12 times at weekly intervals or 5–10 times at fortnightly intervals to prevent oviposition showed that all treatments greatly reduced the rate of loss of fruits due to both fruit-flies and caused a comparable increase in fruit set, especially where the plants were not in full production; applications of 1 lb. 25 per cent. malathion with 0·5 lb. hydrolysed yeast protein in 12 U.S. gals. water per acre at fortnightly intervals caused an initial reduction in infestation but no further decrease, and it is concluded that weekly applications of 1 lb. 25 per cent. wettable malathion with 0·5 lb. of the yeast protein or fortnightly applications of 3 lb. 25 per cent. wettable malathion with 1 lb. of the protein per acre are the most practical.

Tanada (Y.). **Field Observations on a Microsporidian Parasite of *Pieris rapae* (L.) and *Apanteles glomeratus* (L.).**—*Proc. Hawaii. ent. Soc.* **15** no. 3 pp. 609–616, 7 refs. Honolulu, 1955.

The following is based on the author's summary. *Perezia mesnili* was found attacking *Pieris rapae* (L.) in several of the Hawaiian Islands in 1953, over 45 per cent. of the fourth- and fifth-instar larvae on crucifers at Manoa, Oahu, and over 74 per cent. of those at Waimanalo being infected. The incidence of infection was high in both an unsprayed area and one that had been sprayed with DDT and phosphorus insecticides, and a large proportion of the eggs and adults were also infected. The population of *Apanteles glomeratus* (L.), which parasitises the larvae, was high in the unsprayed area, but low in the sprayed one. Larvae of this Braconid found in infected larvae of *P. rapae* were also infected, as also were usually the adults that developed from them. Infected females of *A. glomeratus* deposited viable eggs. *Perezia mesnili* is probably transmitted to successive generations of *Pieris rapae* through the egg, by ingestion and by *A. glomeratus*; egg transmission appeared to be one of the principal methods in the field.

Tanada (Y.). **Susceptibility of the Imported Cabbageworm to Fungi: *Beauveria* spp.**—*Proc. Hawaii. ent. Soc.* **15** no. 3 pp. 617–622, 3 figs., 13 refs. Honolulu, 1955.

The following is substantially the author's summary. Laboratory investigations in Hawaii showed that larvae of *Pieris rapae* (L.) infested by *Beauveria bassiana* or *B. globulifera* died in 2–7 days. Pupae appeared susceptible to these fungi only during the first day after formation, and, in two tests, the eggs were resistant to *B. bassiana*. The symptoms observed are described. A few larvae were found infested by *B. bassiana* on cruciferous crops in the field.

Verma (J. S.). **Biological Studies to explain the Failure of *Cyrtorhinus mundulus* (Breddin) as an Egg-predator of *Peregrinus maidis* (Ashmead) in Hawaii.**—*Proc. Hawaii. ent. Soc.* **15** no. 3 pp. 623–634, 1 fig., 9 refs. Honolulu, 1955.

Since *Cyrtorhinus mundulus* (Bredd.), which gives effective control of *Perkinsiella saccharicida* Kirk. on sugar-cane in Hawaii, is relatively ineffective against *Peregrinus maidis* (Ashm.) on maize [*cf. R.A.E.*, A **44** 125], investigations were carried out on the bionomics and interrelations of the latter and *C. mundulus*. *P. maidis* oviposits in the roots and lower stems of small maize plants, reaching them by way of ant burrows, and in the upper surface of the midribs of the leaves of larger ones, always

choosing those that are succulent. The females deposit an average of about 200 eggs each, usually in the morning or late afternoon, when wind velocity is low. The nymphs are gregarious and are found under the leaf sheaths, or on the roots if ant burrows are near, and can continue to develop on the stems for nearly a month after the maize is dry. The adults are also gregarious and shelter from the wind on the plants or underground in ant burrows, tending to congregate on the plants in the more protected positions in a field.

The eggs of *C. mundulus* are laid singly, usually in the egg cavities made by *P. maidis* and mainly in the midribs, and neither eggs nor nymphs have been observed on young maize. In the laboratory, the females preferred old hard midribs to young succulent ones, and eggs laid in young leaves did not hatch. Ten individuals laid 29–189 eggs each in 4–20 days and lived for 12–26 days; unfertilised females oviposited normally, but the eggs did not hatch. The egg and nymphal stages lasted 7–12 and about 13 days, respectively, and males and females occurred in equal numbers. Both nymphs and adults sucked the eggs of *P. maidis*, adults destroying 10–12 a day each in the laboratory. Like *P. maidis*, *C. mundulus* tended to congregate in the sheltered part of the field early in the season, but as the maize ripens, the leaves open and provide more shelter, and distribution becomes more uniform. Comparison of populations showed that the distribution of *C. mundulus* was independent of that of *P. maidis*.

The ants that are common in maize fields are *Pheidole megacephala* (F.), *Solenopsis geminata rufa* (Jerd.), *Paratrechina longicornis* (Latr.) and *Cardiocondyla nuda minutior* Forel, of which the first three have been seen attending *Peregrinus* nymphs and adults. *Pheidole* has been observed attacking the nymphs of *Cyrtorhinus mundulus*.

It is concluded that *C. mundulus* does not control *Peregrinus maidis* effectively because the stages of maize growth suitable for oviposition and egg development of the two species do not coincide, *Peregrinus* eggs laid in the roots are not accessible to the predators, ants that favour *Peregrinus* attack *Cyrtorhinus*, and maize develops over too short a period and affords insufficient protection against wind for the predator to show its maximum effectiveness.

European and Mediterranean Plant Protection Organisation. **San José Scale in Europe in 1953, 1954.** [*In English and French.*]—[3+] 12 + xi pp.; [3+] 9 + viii pp., multigraph. Paris, 1954, 1955. **San José Scale in Europe and the Mediterranean Basin in 1955.** [*In English and French.*]—[3+] ix + 9 pp., multigraph. Paris, 1956.

These three reports are based on information supplied by countries in correspondence with the European and Mediterranean Plant Protection Organisation and include information not only on the distribution of *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.) in them but also on the control measures in use and the plants attacked. The countries recorded as infested in the first of them are Algeria, Austria, France, Federal Germany, Italy, Portugal, Spain, Switzerland and Yugoslavia, and no important changes are reported in the two later ones. The Coccid is of importance mainly on fruit trees and bushes and nursery stock. The areas of general infestation in Austria and Yugoslavia extend to the frontiers of Rumania, Hungary and Czechoslovakia [*cf. R.A.E.*, A **40** 52, etc.], but information from these countries was not available.

The pest appeared in 1953 to be spreading only in France and Yugoslavia. In France, it was established mainly in the centre, east and south, and some spread was recorded in the Departments of Alpes-Maritimes, Gard,

Isère and Bas-Rhin, though in general the intensity of attack decreased in commercial orchards. In Yugoslavia, infestation was general in the north and more scattered in the south and became more serious in 1953, particularly in Croatia. In 1954, there was no further spread in France, no information was received from Yugoslavia, and there was a reduction in the area infested in southern Switzerland, as a result of extensive eradication campaigns. In 1955, infestation continued to spread in Yugoslavia, both stone and pome fruits being attacked, and it is estimated that over 12,000,000 trees were infested. In most of the other countries, there was a decrease in the intensity of attack as a result of the application of control measures.

VALDEYRON-FABRE (L.). **Observations sur la biologie de** *Brachytrypes megacephalus* **Lef. en Tunisie.**—*Rev. Path. vég.* **34** fasc. 3 pp. 136–158, 20 figs., 13 refs. Paris, 1955.

Brachytrypes megacephalus (Lef.), which is very polyphagous, has occasionally caused considerable damage to young fruit and other trees in nurseries in Tunisia. Some growers, however, consider that the burrowing activities of this Gryllid, which is most frequently found in the irrigation hollows or channels surrounding the trees, are beneficial, assisting in the aeration of the sandy soil. The literature on it is reviewed, and an account is given of investigations on its bionomics, carried out near Tunis. These showed that there is only one generation a year. Pairing occurred in April, and the females laid their eggs in the soil in May. The nymphs hatched in June and burrowed in the soil. The nymphal stage was completed in September, but the adults did not become sexually mature until the following spring and overwintered in the burrows, which reached considerable depths. The Gryllids were most active at the end of summer, burrowing extensively and foraging by night, storing leaves, flowers, fruits and other plant parts in chambers at the ends of the burrows. These latter were easily located by the small mounds on the surface, in which the entrances were often concealed. Individuals of either sex always lived singly in their burrows, resisting all intrusion by other insects. Numerous wild and domestic animals and birds are predacious on the Gryllid, but most control was given by *Sphex xanthoceros* Ill., which appears to be a specific parasite of *B. megacephalus*. The females laid a single egg on the abdomen of the host after paralysing it momentarily, usually in the burrow. The egg hatched in five days at about 25°C. [77°F.], and the parasite larva became full-fed in about ten days, the host dying about two days before. Should it be desirable to take measures against the Gryllids, control by means of natural enemies is considered more advisable than the use of insecticides.

HOFFMANN (A.). **Éthologie comparative de deux espèces affines du genre** *Ceuthorrhynchus*, **nuisibles aux crucifères.**—*Rev. Path. vég.* **34** fasc. 3 pp. 165–178, 18 figs., 16 refs. Paris, 1955.

As a result of rearing experiments on rape and cabbage in France in 1953–54, an account of which is given, the author concludes that *Ceutorhynchus assimilis* (Payk.) and *C. gallo-rhenanus* Solari [*cf. R.A.E.*, A **42** 408] are distinct species, and that the existence of two such closely related forms on crucifers in France accounts for apparent discrepancies in reports of the bionomics of *C. assimilis* [*cf.* **42** 321, 407–408]. Characters are given differentiating the two species in the larval, pupal and adult stages. In the experiments, *C. assimilis* developed normally on both plants, ovipositing in the young pods. *C. gallo-rhenanus* also oviposited on both

plants, the eggs being laid in the flower buds, but development was completed only on cabbage, the flowers of rape opening before the eggs could hatch and the latter being found dried up.

In 1953 when climatic conditions were normal, adults of *C. assimilis* emerged from hibernation after those of *C. gallo-rhenanus*, and oviposition by the former began some 5–15 days after that by the latter; but, in 1954, when the weather was unfavourable for spring emergence, adults of both species appeared at about the same time. Similarly, although males normally emerge 8–10 days before females, the two sexes appeared simultaneously in 1954. Pairing occurred almost immediately after emergence, and it is assumed that the adults of both species had become sexually mature before overwintering. Oviposition was observed 10–20 days after pairing, but relatively few eggs were laid. The larval stage lasted 28–48 days for *C. gallo-rhenanus* and 50–60 for *C. assimilis*. On cabbage, the egg of *C. gallo-rhenanus* was deposited at the base of the ovary through the side of the calyx, and hatched when the bud began to open, after about 6–10 days. The larva remained quiescent for 2–3 days, and then gradually attacked the young pod, which it entered 6–8 days later. The species is also recorded from turnips, and it was not common near Paris.

Grison (P.) & Le Berre (J. R.). **Observations concernant l'enfouissement estival naturel du doryphore** *Leptinotarsa decemlineata* **Say au cours des cinq dernières années.**—*C.R. Acad. Agric. Fr.* **40** no. 7 pp. 257–259, 5 refs. Paris, 1954.

In the experiments described, which were carried out at Versailles in 1949–53, newly emerged first-generation adults of *Leptinotarsa decemlineata* (Say) were caged over soil, provided daily with fresh potato foliage and observed for mortality or entry into the soil for hibernation [*cf. R.A.E.*, A **35** 311]. The results are given in tables and showed that of the beetles that did not die, half entered the soil within 7–11 days and all within 21–43 days, except in 1950, when the periods were 21 and 54 days, respectively. Mortality varied with the number of days spent on the soil surface and reached 60 per cent. in 1950 and 11–39 per cent. in the other years. It was also noted that the period before entry was shortest in the years in which the adults had emerged latest. The actual dates on which the adults were collected and those on which entry into the soil was complete were 20th July and 2nd September in 1949, 10th July and 3rd September in 1950, 4th August and 2nd September in 1952, and 7th August and 29th August in 1953.

It appeared that high temperatures and low relative humidities were responsible for entry into the soil during the first ten days. Later, low temperature above the threshold of activity appeared to be the determining factor. Rain combined with temperatures below 20°C. [68°F.] caused 10–20 per cent. mortality of the newly-emerged beetles. It is concluded that chemical treatments against first-generation adults should be applied as soon as emergence has begun, in view of the rapidity with which they re-enter the soil.

Toumanoff (C.) & Grison (P.). **Études préliminaires sur l'utilisation des bactéries et champignons entomophages contre les insectes nuisibles.**—*C.R. Acad. Agric. Fr.* **40** no. 7 pp. 277–280, 13 refs. Paris, 1954.

Numerous strains of entomogenous fungi and bacteria have been tested in the laboratory in France by the authors since 1949, and the results are given of experiments in which three strains of *Bacillus cereus*, referred to

by Toumanoff as var. P3, var. *cazaboun* and var. *alesti*, were used in suspension sprays containing about 20,000,000 spores per cc. with 5 per cent. dextrin as a wetting agent. In a test against newly hatched larvae of *Gnorimoschema operculella* (Zell.) on potato tubers, the mortality percentages obtained in ten days (calculated according to Abbott's formula [*R.A.E.*, A **13** 331]) were 17 for var. *cazaboun* and 28 for var. P3, as compared with 79 for treatment with an unspecified BHC product. In a further test, carried out at 20–25°C. [68–77°F.] and a relative humidity of 65–70 per cent., the mortality percentages for larvae of *Pieris brassicae* (L.) given by var. *alesti* and var. P3, with (in brackets) the percentages among untreated larvae, were 100 and 100 (20) for the third instar, 100 and 100 (45) for the fourth instar, and 80–90 and 100 (0–10) for the fifth instar. The corresponding percentages were 90–100 and 90 (20–40) for sixth-instar larvae of *Malacosoma neustria* (L.) and 70–76 and 83–100 (22–25) for first- and second-instar larvae of *G. operculella*. Complete mortality of all the larvae of *Pieris* and *Malacosoma* was given by an unspecified DDT product. Further tests with *P. brassicae* showed that control of third-instar larvae was effective at all temperatures between 16 and 32°C. [60·8 and 89·6°F.], but that 4–5 days were required for complete mortality at the extremes, as compared with three days at 22 or 28°C. [71·6 or 82·4°F.]. Larvae in the first two instars all died in 24 hours, those in the third instar in 2–3 days, and those in the last instar in up to five days. When larvae were placed on leaves from cabbage plants that had been sprayed two days previously with a spore suspension to which 2 per cent. bentonite had been added, complete mortality of first-instar larvae was given in four days. Larvae in the third instar were not killed, but pupated five days later than those on untreated leaves. The leaves ceased to be infective within a week of treatment.

In a field test on apple, *Beauveria globulifera* gave 58 per cent. mortality of older larvae of *Hyponomeuta* [*padellus malinellus* Zell.], as compared with 10 per cent. mortality for no treatment, but fungi gave less satisfactory results in general than did the bacteria.

Rambier (A.). **Un acarien nuisible méconnu: le tétranyque du pommier (*Amphitetranychus viennensis* Zacher, 1920).**—*C.R. Acad. Agric. Fr.* **40** no. 8 pp. 340–343, 5 refs. Paris, 1954.

Tetranychus (*Amphitetranychus*) *viennensis* Zacher has become of importance on fruit trees, particularly apple, in the Mediterranean region of France [*cf. R.A.E.*, A **44** 22, etc.], mainly as a result of the widespread application of modern insecticides in orchards, and the author gives a brief account of its distribution and of its bionomics, based on observations in 1953. The females overwintered in groups, mainly in cracks in the bark or in the soil round the trees, became active in spring, and dispersed to the young leaves. At Montpellier they became active about 25th March and were found on all parts of the trees by 7th April. They fed and oviposited on the lower surface of the outer leaves of the terminal buds. Natural mortality was high in spring and increased still more in May–June, owing to the activities of predators, one colony on apple being destroyed by *Stethorus* (*Scymnus*) *punctillum* Weise during May. However, large populations developed in summer, under the influence of high temperatures, long hours of daylight, an abundance of mature leaves, and the destruction of natural enemies by organic insecticides or acaricides. Maximum numbers were present in August and September, and the hibernating females were produced in early autumn and entered diapause in late September or early October, when the critical photoperiod was 13–14 hours per day [*cf.* **42** 317]. The last males and eggs were seen in October.

Thermes (R.), Delmas (H. G.) & Cessac (M.). **Premières études sur la lutte contre la noctuelle de l'artichaut en Roussillon.**—*C.R. Acad. Agric. Fr.* **40** no. 8 pp. 344–348, 1 ref. Paris, 1954.

An account is given of observations in Roussillon in 1951–53 on the bionomics and control of *Hydroccia xanthenes* (Germ.), which causes serious injury to globe artichokes [*Cynara*]. The adults emerged in the second half of October and in November, and the eggs were laid, not on the plants, as in Provence [*cf. R.A.E.*, A **28** 278], but in cracks in the bark of trees round the fields and on stakes, fences and windbreaks. The females laid 122–1,013 eggs each, with an average of about 500, in 3–4 batches. The egg stage lasted about 2½ months, the larvae hatching between 7th January and 24th February in 1952. They entered the leaves within a few hours and mined in the veins, and later mined in the stalks of the inflorescences and main stems. Pupation occurred during September in the stems at soil level.

In laboratory tests against the newly hatched larvae, groups of ten individuals 1–2 days old were placed on leaves that had been treated in the field on the previous day. Complete mortality, before the larvae could enter or could complete their entry into the leaves, was given within ten hours by dusts of 2 per cent. dieldrin or 5 per cent. DDT and by an emulsion spray of 0·03 per cent. parathion. When similar groups were placed in petri dishes with portions of treated leaves, complete kill was given in two hours by a dust containing 0·6 per cent. γ BHC as lindane and in eight by emulsion sprays of 0·03 per cent. parathion or 0·06 per cent. DDT, and a dust of 2 per cent. dieldrin, other materials proving less effective, but when the leaves had been treated eight days previously, only the γ BHC dust killed all the larvae in 18 hours, though the DDT dust killed almost all of them. All the materials gave complete kill in 45 hours.

In a field test, treatments were applied on 7th and 30th January and 11th and 21st February. The plants were examined on 2nd June, and the average percentages of plants attacked, as compared with 51·1 for no treatment, were 14·3, 20, 31·4 and 44·3 for dusts of 2 per cent. dieldrin, 10 per cent. chlordane, 0·6 per cent. γ BHC and 5 per cent. DDT, respectively, and 27·1 and 41·4 for emulsion sprays containing 0·03 per cent. parathion and 0·06 per cent. DDT, respectively. Dieldrin was significantly better than all other treatments except chlordane. Parathion was significantly better than DDT.

La Face (L.). **Sul comportamento invernale e primaverile della mosca dell' olivo** (*Dacus oleae* **Gmel.) in Provincia di Latina ed alcune norme di lotta contro l'insetto.** [On the Behaviour of *D. oleae* in Winter and Spring in the Province of Latina and some Suggestions for its Control.] —*Riv. Parassit.* **15** no. 2 pp. 95–101. Rome, 1954. (With a Summary in English.)

Observations in the Province of Latina, to the south of Rome, indicated that the females of *Dacus oleae* (Gmel.) that oviposit in young olives there in July consist of individuals of the autumn generation that emerge in storehouses and olive presses during the winter and fly out into the open in spring, individuals of the same generation that emerge from pupae that overwinter in the soil or in olives on the trees, and individuals of the spring generation that develops on late olives in localities in which these are left on the trees until early summer. Storehouses and olive presses afford comparatively favourable conditions for overwintering. Larvae that have not left the unpicked fruits to pupate by the onset of cold weather in autumn continue their development very slowly until the olives are picked,

when the higher temperatures in the storage premises induce rapid completion of development, pupation in cracks and crevices, and emergence of adults. Larvae that pupate in the soil in groves in which the olives are picked very late are thought to originate from fallen fruits, and no puparia were found in the soil in plantings in which picking had been completed in autumn.

It is evident therefore that the overwintered population could be reduced by early picking and pressing of the olives and closing of the presses at the beginning of winter, combined with cleaning of the presses and treatment with a long-acting contact insecticide before harvest. This would entail abandonment of the cultivation of slow-ripening table varieties, which should not be grown where the fly is present. It would also be desirable to prevent the collection of olives remaining on the ground after harvest by poor persons who accumulate them until they have sufficient for pressing, since these may also give rise to adults in winter.

SCHIMITSCHEK (E.). **Schlüssel zur Bestimmung der wichtigsten forstlich schädlichen Käfer.** [Key to Identification of the most important Coleoptera injurious in Forestry.]—2nd revd. edn., iv + 109 pp., 3 pls., 134 figs. Vienna, Springer-Verlag, 1955.

This second edition of a work already noticed [*R.A.E.*, A **26** 312] has been expanded by the inclusion in the main key of various Coleoptera that have recently become of importance in the forests of Central Europe, either as pests or as beneficial insects, and were not previously included, and the addition of an introductory section on the structure and parts of the insect body, a glossary of technical terms, and a key permitting the larvae to be identified as to family or family group.

BÖHM (H.). **Untersuchungen über die Biologie und Bekämpfung der Roten Stachelbeermilbe (*Bryobia practiosa* Koch).** [Investigations on the Bionomics and Control of the Red Gooseberry Mite (*B. practiosa*).]—*Pflanzenschutzberichte* **13** pt. 11–12 pp. 161–176, 1 fig., 12 refs. Vienna, 1954. (With a Summary in English.)

Bryobia practiosa Koch has recently caused much injury to fruit trees and bushes in parts of Austria, and as little was known there of the life-history and control of this mite, investigations were carried out in 1950–53 in Vienna and Lower Austria. No males were observed. All stages of the females are described, and a list is given of over 25 plants found to be infested. In addition to fruit trees and bushes, they included vines, forest trees, ivy (*Hedera* sp.), clover, lucerne, hops and various weeds and grasses.

Races of *B. practiosa* restricted to certain food-plants have been reported from other countries [*cf. R.A.E.*, A **44** 320, etc.], and tests were therefore carried out on the ability of the mites from plants of one species to colonise another. The method used was to attach pieces of bark bearing winter eggs to plants of different species or to tie together the twigs of infested and uninfested plants. In this way, the mites were successfully transferred from apple to pear and plum, from gooseberry to currant and from ivy to clover and grasses, but not from gooseberry to fruit trees or the reverse or from ivy to fruit trees or bushes. Field observations also showed that uninfested gooseberry bushes occurred beneath heavily infested apple trees and uninfested ivy among infested gooseberry bushes. There were no morphological differences between the mites from the different plant species.

The life-cycle on apple, gooseberry and ivy was studied by isolating the newly-hatched mites on plant tips by means of rings of adhesive and transferring them to fresh plants as soon as eggs were laid, the process being

repeated in each generation. The symptoms of infestation were the same on all three plants, consisting of whitish spots or patches on the upper surfaces of the leaves (due to the entry of air into the emptied cells), rolling of the leaves, and premature leaf fall, and resulted in dropping of the unripe fruits and poor fruit-bud formation. Gooseberry was particularly severely affected, whole bushes being sometimes killed. Development was dependent on temperature and was favoured by dry warm weather and also apparently by light sandy soil. In a constant-temperature apparatus, 15–17°C. [59–62·6°F.] was the optimum for the hatching of the winter eggs, which was much delayed at lower temperatures, and development from egg to adult female lasted 45–50 days at 10°C. [50°F.], 25–28 days at 15°C.; 17–21 days at 20°C. [68°F.], and 15 days at 25°C. [77°F.], the temperature limits being 7 and 40°C. [44·6 and 104°F.]. Mortality at temperatures approaching the limits was high.

On apple or other fruit trees, winter was passed exclusively in the egg stage, the eggs occurring round the buds, in forks and in crevices in the bark of trunks and branches, and occasionally on the root collar and in the upper soil layer. Hatching began in late March or early April on apple, and the mites fed on the leaves but moved to the bark to moult. The larval and two nymphal stages each ended with a resting period, there were four generations a year, each lasting 4–6 weeks, and the females laid up to 45 eggs each, with an average of 30, mostly on the lower surfaces of the leaves. Some of the eggs of the second and third generations and all those of the fourth overwintered. On gooseberry, winter was also passed in the egg stage. Hatching occurred at the same time as on apple, and adult females were present by mid-May. They oviposited 4–5 days later, laying not more than 10–25 eggs each, with an average of 15, and all the eggs overwintered, so that there was but one generation a year. On ivy, no overwintering eggs were seen, and winter was passed by the nymphs and adults. The mite is less common on this plant than on some others, and the females laid only 8–10 eggs each on it, beginning in mid-May. Development required three months, and the first-generation females laid eggs in the second half of August, from which the overwintering population developed. The only natural enemies observed were predators, comprising *Anthocoris nemorum* (L.), *Stethorus* (*Scymnus*) *punctillum* Weise, Hemerobiids and Chrysopids.

Experiments on control were carried out with winter and summer sprays. The best results against winter eggs, sprayed or dipped in February–March, were given by preparations of DNC in oil diluted to 5 per cent. and mixtures of tar distillate and oil diluted to 7·5 per cent., which gave about 80–85 per cent. control in the laboratory and about 70–80 per cent. in the field. Lime-sulphur had little or no effect on the eggs but killed almost all the mites that came into contact with the deposit on hatching. Summer sprays were applied in the field in late April or early May, and the results showed that Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate (demeton)] at 0·05 per cent. gave complete control throughout the season, even though applied after oviposition had begun. A parathion product (E 605 forte) and lime-sulphur were equally effective initially but showed no control after about five weeks.

MATHYS (G.). **Le problème de la lutte contre les araignées rouges de la vigne.**—*Rev. rom. Agric.* **10** no. 10 pp. 81–84, 4 figs., 2 graphs. Lausanne, 1954.

Increasing damage by Tetranychids has been observed in vineyards in French Switzerland in recent years, the species chiefly concerned being

Metatetranychus ulmi (Koch). In 1954, the winter eggs, which are laid on the vine stocks, began to hatch about 20th April, and there appeared to be three generations in summer and a fourth in September. Preliminary investigations on natural enemies showed the most important to be predacious mites of the genus *Typhlodromus*, each of which was capable of destroying 20–25 examples of *M. ulmi* in two days. They also attacked the eggs and in the absence of prey fed on the sap of the vine leaves. The predators overwintered in the adult stage, and the females oviposited in mid-May, usually laying about 12 eggs each, preferably on the lower surface of the leaves. Observations on the populations of *Metatetranychus* and *Typhlodromus* were made on vines of three varieties that were treated in 1954, for the second successive year, with Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], parathion, G 388 [ethyl 4,4'-dichlorobenzilate] and Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate (demeton)]. On the first variety, which was severely infested by *M. ulmi* but bore very small populations of *Typhlodromus*, the numbers of *M. ulmi*, including eggs, per leaf in late May, 21 days after treatment, were about 5, 3, 2 and 0·5 for Diazinon, parathion, G 388 and demeton, respectively, as compared with 14 for no treatment. On the other two varieties, demeton destroyed both *M. ulmi* and the predators; parathion also destroyed the predators, but resulted in a considerable increase in the numbers of *M. ulmi*, probably owing to acquired resistance in this mite. Diazinon and G 388 did not completely destroy *Typhlodromus* and gave fair control of *M. ulmi*. The use of demeton on vines is not advised, both on account of its harmful effect on natural enemies and because of the possibility of toxic residues persisting in the grapes.

Additional observations in June 1954 showed that populations of *Typhlodromus* on vines treated with copper carbonate were about 14 times as great as on those treated with an organic sulphur compound, and that there were three times as many of *M. ulmi* on the latter as on the former.

Mathys (G.). **Étude faunistique des acariens des pommiers en Suisse romande.**—*Landw. Jb. Schweiz* **69** pt. 7 pp. 815–825, 4 figs., 12 refs. Berne, 1955. (With Summaries in German, English and Italian.)

In view of the increase of phytophagous mites on fruit trees in French Switzerland following the application of modern insecticides against insect pests, investigations on the status of the mites present on apple there were begun in 1950 in both well cultivated and neglected orchards, particular attention being paid to predacious species. The mites collected are classified as phytophagous, predacious or saprophagous, and a list of them is given. Of the phytophagous mites, only *Metatetranychus ulmi* (Koch), *Tetranychus telarius* (L.) (*urticae* Koch) and *Bryobia practiosa* Koch were of major importance, and notes are given on their bionomics [*cf. R.A.E.*, A **41** 180]. *M. ulmi* was the most numerous of them in the well cultivated orchards. *T. telarius* was of significance because of its high reproductive capacity and the fact that it is active from early March, ovipositing on herbaceous plants beneath the trees and later returning to the latter. *B. practiosa* is killed by sulphur sprays and was almost completely absent from orchards sprayed with lime-sulphur, though it was present in moderate numbers on neglected trees. The other phytophagous mites, which comprised *Brevipalpus geisenheyneri* (Rübs.) and species of *Tydeus*, *Tarsonemus* and *Eotetranychus*, were held in check by predators and by the fungicidal and insecticidal treatments normally applied, so that damage by them was of no importance.

The predacious mites observed comprised *Typhlodromus tiliae* Oudm., *T. vitis* Oudm., *T. finlandicus* (Oudm.), *Eupalopsis* sp., *Mediolata* sp. and *Neophyllobius vanderwieli* Oudm., and they were particularly numerous in an orchard in which control measures had not been applied for some 20 years. *T. tiliae*, which is one of the most important natural enemies of *Metatetranychus ulmi*, was the most abundant. It overwinters in the adult stage, and oviposition begins in mid-May. Three summer generations were observed in 1954, but it is thought that there may be four when climatic conditions are more favourable. In the absence of other mites, it fed on plant juices. In view of the importance of *T. tiliae* as a predator, small-scale tests were made in the laboratory on its susceptibility to insecticides and fungicides. Parathion and Systox (demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate]) at 0·1 per cent. rapidly killed all the mites on leaves sprayed with them, and considerable mortality was also caused by DDT, zineb (zinc ethylene bisdithiocarbamate) and various sulphur sprays. The saprophagous mites were of no practical importance, but some of them may serve as alternative food for the predacious species when phytophagous mites are scarce.

Savary (A.) & Baggiolini (M.). **Contribution à l'étude de la lutte contre le carpocapse des pommes et des poires** (*Enarmonia pomonella* **L.**).— *Landw. Jb. Schweiz* **69** pt. 7 pp. 827–864, 17 figs., 25 refs. Berne, 1955. (With Summaries in German, English and Italian.)

Since the successful control of *Cydia* (*Enarmonia*) *pomonella* (L.) on apple and pear in French Switzerland depends largely on the timing of sprays, investigations with a view to improving this were carried out in 1953–54. The catches of adults in bait-traps are widely used there to recommend the date of the first treatment, others being applied at intervals of 20 days, according to weather, but this method has several disadvantages, including the absence of information as to late-season flights and the consequent premature cessation of treatments in some years. Geier obtained promising results in 1953 with light-traps of the Robinson type [*cf. R.A.E.*, A **43** 169] fitted with a mercury-vapour lamp. More adults were taken in the bait-traps than in the light-traps at the beginning of the season, but the position was reversed at the end of it. There was an evident correlation between the numbers of adults taken in the light-traps and the attack on the fruits, and the catches also reflected the emergence of adults of the first generation.

In view of these results, studies with traps of the two types were continued in the following year, and a detailed account of the work is given. The results obtained were less favourable. In one area, no serious attacks followed catches of large numbers of adults in both types of traps, and the treatments applied proved unnecessary, whereas considerable damage occurred in another area though only small numbers of adults had been taken in the light-traps. In yet another area, fairly accurate results were obtained. The respective advantages and disadvantages of traps of the two types are discussed, and as it appears that the information obtained from either must be supplemented by other observations on moth activity, the various ways in which this can be done, including rearing in outdoor cages and observations of the intensity of oviposition, are reviewed. Owing to the diversity of local conditions, such observations are required in each particular area. Growers are advised to study conditions in their own orchards, and not to neglect supplementary control measures, such as treatment of storehouses against overwintering larvae, the use of trap

bands, and the protection of birds, which destroy large numbers of the overwintering larvae.

LEIN (H.). **Kålfluene (*Hylemyia brassicae* Bouché & *H. floralis* Fallén). Undersøkelser over deres biologi og bekjemping i Norge.** [The Cabbage Root Flies *H. brassicae* and *H. floralis*. Investigations on their Bionomics and Control in Norway.]—*Meld. Plantev.* no. 9, 65 pp., 6 figs., 19 refs. Oslo, 1955. (With a Summary in English.)

Hylemyia brassicae (Bch.) and *H. floralis* (Fall.) are responsible for most of the damage to cabbage and other cruciferous crops by root flies in Norway. Investigations on their bionomics and control have been in progress since 1942, and an account is here given of the results obtained, mainly in 1951–53. The damage caused by these Anthomyiids has increased with time, particularly in coastal districts. Both species occur throughout the country as far north as 70°N. lat., but *H. floralis* is the more numerous of the two, *H. brassicae* being of little importance in the north and in the mountainous districts of the south-east. The observations showed that *H. brassicae* has two generations a year, though the second is not numerous and sometimes absent, and that *H. floralis* has only one. Oviposition by *H. brassicae* begins in late May or June in the extreme south and in June elsewhere, and the larvae are active in June–July. Second-generation larvae occur in August–October. The oviposition period of *H. floralis* is variable from year to year, the limits being early June and late August, and the larvae are active from July–August to October. In both species, the pupae overwinter. All stages of the two and the damage caused are described.

Control experiments against both flies were carried out on swedes and cabbage by means of numerous organic insecticides. On swedes, drenches were applied to the soil round the plants about a week after oviposition by *H. floralis* had begun. The best results were given by 0·4 per cent. of a 40 per cent. chlordane emulsion concentrate, 0·5 and 0·2 per cent. of emulsion concentrates containing 6 and 15 per cent. γ BHC as lindane, respectively, 0·3 per cent. of a purified BHC preparation containing 10 per cent. γ BHC, and 0·4 per cent. of an emulsion concentrate containing 15 per cent. chlordane and 5 per cent. γ BHC. The effect on yield increased with the intensity of infestation, and the increase was between three- and fourfold in some tests. Dusts applied round the plants in July, before the appearance of the larvae, were in general less effective, but the 40 per cent. chlordane concentrate similarly applied in sawdust (1:480) gave excellent results. The γ BHC and chlordane drenches gave very good results on cabbage, as also did a 5 per cent. chlordane dust. The latter and also dusts of 1·5 per cent. γ BHC and 2·5 per cent. dieldrin gave some protection when mixed with the potting soil. Various insecticides were tested in slurries in which the roots of cabbage plants were dipped before transplanting. Increases in yield were obtained in many cases, but there were phytotoxic effects in most of the tests, especially with γ BHC in the form of an emulsion concentrate. BHC dusts were less injurious. The slurries recommended comprise emulsion concentrates of 40 per cent. chlordane or 15 per cent. dieldrin diluted to 0·5 per cent., and 6 and 2·5 lb. of dusts containing 0·65 and 1·5 per cent. γ BHC, respectively, per 10 gals. of clay paste.

Observations on the natural enemies of the two flies, carried out by collection and rearing of pupae, showed that the most important were the predacious *Aleochara bilineata* Gylh. and the parasite *Trybliographa rapae* (Westw.), of which the latter was the more numerous. Other parasitic Hymenoptera were not frequent.

Fjelddalen (J.) & Stenseth (C.). **Bekjempelse av løkflue** (*Hylemyia antiqua* **Meig.). Foreløbig melding.** [The Control of the Onion Fly (*H. antiqua*). Preliminary Report.]—*Meld. Plantev.* no. 11, 25 pp., 2 graphs. Oslo, 1956. (With a Summary in English.)

Organic insecticides were compared for the control of *Hylemyia antiqua* (Mg.) on onion in 35 tests in Norway in 1953–55. In that country, the eggs are laid from the end of May onwards, and there is one generation a year, with a partial second. On onions grown from seed, two applications of a spray containing 0·4 per cent. of a 40 per cent. chlordane emulsion concentrate in late May and mid-June almost tripled the plant stand and greatly reduced the percentage attack; 0·2 per cent. of an emulsion concentrate containing 17·25 per cent. dieldrin was about as effective, but one of γ BHC as lindane was inferior. Chlordane and dieldrin gave as good results when applied as drenches, but greater volumes of liquid are required for this method. Both chlordane (5 per cent.) and γ BHC (1·5 per cent.) gave good protection when applied in dusts, chlordane again being somewhat superior, and both were better than a 4 per cent. calomel dust. The chlordane concentrate was about as effective when diluted to 0·4 per cent. and used as a seed dressing, and proved superior to DDT, γ BHC, aldrin and dieldrin, though these also gave good protection. The same treatments were also applied to onions grown from setts, dipping or coating with dry insecticides being substituted for seed treatment, and gave broadly similar degrees of protection as measured by percentage infestation, though the dry coatings applied to moistened setts caused plant injury. The best of the dips were the chlordane and dieldrin concentrates at 2·5 per cent., and emulsified solutions of 1·5 per cent. DDT or 0·3 per cent. γ BHC; they caused little or no plant injury.

McMahon (E.). **Investigations on the Hatching of the Eggs of the Lemon Wheat Blossom Midge.**—*Sci. Proc. R. Dublin Soc.* (N.S.) **26** no. 20 pp. 339–345, 2 figs., 8 refs. Dublin, 1954.

Contarinia tritici (Kby.) caused severe losses in the yield of wheat in the south and south-east of the Republic of Ireland in 1951, when conditions were very favourable for this Cecidomyiid. The weather was less favourable in 1952, and even where infestation did occur, damage was less than expected. Since atmospheric humidity was low in June and it was thought that the dry conditions might have retarded the development of the eggs or prevented hatching, experiments were carried out in the laboratory in 1953 to ascertain the influence of temperature and humidity on them.

Wheat plants with newly emerged ears, most of which bore eggs, were taken from the field and the upper parts inserted into specially constructed perspex cages, which are described, and kept at different temperatures and humidities. The eggs hatched in two days at 80–85°F. and 100 per cent. relative humidity, in three days at 70–75°F. and 100 per cent. relative humidity, in four days at 70–75°F. and 45–50 per cent. relative humidity, also in four days at laboratory temperature (maximum day temperature 73–84°F. and minimum night temperature 52–64°F.) and when the relative humidity was 100 per cent. or water was sprayed frequently into the chamber, and in five days at laboratory temperature and a relative humidity of 60 per cent., at laboratory temperature and laboratory humidity, and at 5–7°F. below laboratory temperature and either 50 or 100 per cent. relative humidity. The effect of humidity on eggs in the field would apparently depend on the position in which they are laid. In one sample, about 60 per cent. of the groups of eggs were found under the folds at the tips of the paleae, where they were protected from desiccation and hatched under all

conditions of humidity, but the remainder were laid on the margins of the paleae, where they were exposed when the blossoms opened, and failed to hatch in a dry atmosphere, even when subsequently placed in water. The retardation of hatching in dry conditions is of importance, because eggs that do not hatch before the blossoms open may, if laid on the margins of the paleae, be prevented from hatching altogether.

Boudreaux (H. B.). **New Species of Tetranychid Mites (Acarina).**—*Pan-Pacif. Ent.* **30** no. 3 pp. 181–186, 19 figs. San Francisco, Cal., 1954.

Descriptions are given of the adults of both sexes of *Tetranychus merganser*, sp.n., taken on *Ligustrum vulgare*, *T. cocosinus*, sp.n., taken on *Celtis* sp., *Rubus* and elm (*Ulmus americana*), and *T. magnoliae*, sp.n., taken on *Magnolia grandiflora* and *Liriodendron tulipifera*, all in Louisiana.

Seidel (D. R.). **Two new Dipteran Parasites of** *Autographa californica*.—*Pan-Pacif. Ent.* **30** no. 3 p. 186. San Francisco, Cal., 1954.

The Tachinids, *Madremyia saundersii* (Will.) and *Achaetoneura archippivora* (Will.), were found parasitising 20 per cent. of a small collection of larvae and pupae of *Plusia* (*Autographa*) *californica* Speyer taken on spinach in Walla Walla county, Washington, in October–November 1953. This is thought to be the first record of *A. archippivora* from this host. The pupal stage lasted about 16–17 days for both parasites.

Rosenstiel (R. G.). **Another Weevil injurious to Strawberries.**—*Pan-Pacif. Ent.* **30** no. 3 p. 194, 1 ref. San Francisco, Cal., 1954.

Peritelinus oregonus van Dyke, which was described from examples taken on oak (*Quercus garryana*) in Oregon and has also been found on the leaves of filbert [*Corylus*] and *Achillea lanulosa*, was observed in July 1953 causing severe damage to strawberries near Hillsboro, Oregon. The larvae fed in the crowns of the plants, many of which died, and the adults attacked the edges of the leaves.

Bergamin (J.). **Utilization of Hydroponics in ecological Studies of the Cotton Aphid.**—*Pan-Pacif. Ent.* **30** no. 4 pp. 251–257, 1 fig., 8 refs. San Francisco, Cal., 1954.

An account is given of life-history studies in California in which *Aphis gossypii* Glov. was reared on plants growing in nutrient solution; of the various plants tested, squash appeared the most suitable. The nymphal stage averaged 6·2 days in the laboratory at 70–80°F. and 17·3 days outdoors in winter, and the adults survived for averages of 23·8 days in the greenhouse at 75–80°F. and 17·6 days in the open. The average number of progeny produced per female was 59·9 in the greenhouse and 41 in the open. The method may prove useful for studying factors that induce the appearance of winged forms.

Chao (Yung-chang). **Insects in Grain Elevators at Pullman and Albion, Washington.**—*Pan-Pacif. Ent.* **30** no. 4 pp. 260–262, 3 refs. San Francisco, Cal., 1954.

A list is given of 25 species of insects and a mite found in granaries at two places in Washington State in 1952, mostly in floor samples from empty

bins. *Calandra* (*Sitophilus*) *granaria* (L.) constituted 40·5 per cent. of the total, *Cryptolestes minutus* (Ol.) (*Laemophloeus pusillus* (Schönh.)) and *C.* (*L.*) *turcicus* (Grouv.) 26 per cent., *Oryzaephilus surinamensis* (L.) 22·4 per cent. and *Tribolium castaneum* (Hbst.) 11·1 per cent. Some of the other species are recorded from Washington for the first time or have not previously been observed in granaries in the United States.

Lindgren (D. L.), Vincent (L. E.) & Krohne (H. E.). **The Khapra Beetle, *Trogoderma granarium* Everts.**—*Hilgardia* **24** no. 1 pp. 1–36, 15 figs., 4 pp. refs. Berkeley, Cal., 1955.

The following is based on the authors' summary. *Trogoderma granarium* Everts, a serious pest of stored grain and other food products in India and elsewhere, has recently been found in 23 counties of California, Arizona and New Mexico [*cf. R.A.E.*, A **44** 171, etc.], and a campaign for its eradication is in progress. It thrives in hot, dry conditions and has proved exceptionally difficult to control. The damage is caused by the feeding of the larvae, which prefer cereals and cereal products and attack whole grains, but also feed on dried blood, dried milk and fishmeal [*cf.* **44** 172] and survive for long periods without food.

The average period required for development from egg to adult varied from 220 days at 70°F. to 26 days at 93–95°F.; it appeared to be little affected by darkness or light but varied widely on different foods. At 90°F., egg viability averaged 94 per cent. and the females laid an average of 93 viable eggs each. Exposure of eggs to −6°F. gave erratic results, but some hatched that had been exposed for 40, 80 or 120 minutes. A few fourth-instar larvae survived exposure to this temperature for 240 minutes, and a few also survived exposure to a daily fluctuating temperature of 25–48°F. for 51 days. No pupae survived exposure to −6°F. for 20 minutes. Larvae were also more resistant than pupae to high temperatures (118–131°F.); 95 per cent. kill of the two stages was obtained in 960 and 420 minutes, respectively, at 118°F. and 50 per cent. relative humidity and in eight minutes at 131°F. and 50 per cent. humidity. These results indicate that *T. granarium* might become a pest of grain stored in piles or sacks in the field in a climate such as that of Imperial Valley, California.

Comparison of the dosages of fumigants required to give 95 per cent. kill in two hours at 70°F. showed that the eggs were more susceptible than the larvae or pupae to acrylonitrile, ethylene chlorobromide, ethylene dibromide, methyl bromide, ethylene oxide and hydrogen cyanide; that larvae were more susceptible than eggs or pupae to chloropicrin, and pupae than eggs or larvae to methallyl chloride; and that eggs, larvae and pupae were equally susceptible to carbon bisulphide. Eggs were relatively resistant to fumigation with chloropicrin or methallyl chloride. HCN was the only fumigant of the ten tested to which all the immature stages of *Trogoderma* were more susceptible than adults of *Calandra* (*Sitophilus*) *granaria* (L.). Comparison of the quantities of fumigant required to give 95 per cent. kill with exposures of 2–24 hours at 70°F. showed that HCN and acrylonitrile were the most toxic to the larvae and pupae. Methyl bromide, HCN and acrylonitrile showed some evidence of reducing the germination of a few of the seeds tested when these had a moisture content of less than 10 per cent. and were exposed for 12 hours. Comparison of 22 contact insecticides showed that parathion, methyl-parathion, malathion, O,O-dimethyl O-2-chloro-4-nitrophenyl thiophosphate, Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate], O,O-diethyl S-isopropylmercaptomethyl dithiophosphate and Pyrocide 175 (20 per cent. pyrethrins) were the most toxic to fourth-instar larvae, killing 95 per cent. by topical application of less than 10 mmg. per larva.

The larvae were more resistant than adults of *C. granaria*, *C.* (*S.*) *oryzae* (L.) or *Rhizopertha dominica* (F.) to wheat treated with a malathion dust or a dust mixture of piperonyl butoxide and pyrethrum.

Peairs (L. M.) & Davidson (R. H.). **Insect Pests of Farm, Garden and Orchard.**—5th edn. (revd.), 9¼ × 6 ins., ix + 661 pp., 577 figs., refs. New York, N.Y., J. Wiley & Sons, Inc.; London, Chapman & Hall, Ltd., 1956. Price £3 8*s*.

This fifth edition of an elementary text-book of agricultural entomology for students in the United States [*cf. R.A.E.*, A **9** 396] contains introductory chapters on the structure, development and classification of insects, natural control agents, methods of artificial control, the properties and uses of the various insecticides, and the formulations and equipment available for their application, together with dilution tables and a table of conversions and equivalents. The bulk of the book (pp. 121–580) comprises information on the bionomics, distribution and control of insects and other invertebrates that attack field, orchard or market-garden crops, plants under glass, ornamental plants, shade trees or stored products or are injurious or a nuisance in houses, with the nature of the damage caused by them. A chapter on insects and other arthropods that attack man and livestock is included.

Harcourt (D. G.) & Cass (L. M.). **Toxicities of various Insecticides to Cucumber.**—*Canad. J. agric. Sci.* **35** no. 1 pp. 19–26, 16 refs. Ottawa. 1955.

The following is based largely on the authors' summary. Field experiments were carried out at Ottawa in 1950–52 to determine the effect on cucurbits of frequent applications of insecticidal dusts during June–August to prevent feeding by adults of *Acalymma vittata* (F.) [*cf. R.A.E.*, A **39** 89]. The dusts were applied at intervals of about a week and at an average rate of 30 lb. per acre. Four applications of 1 per cent. rotenone or γ BHC as lindane, 3 per cent. methoxy-DDT (methoxychlor) or nicotine, calcium arsenate diluted 1:10 in talc or copper oxychloride sulphate, or talc with copper oxychloride sulphate (1:10) had no harmful effects on cucumber plants of a variety known to be susceptible to damage by insecticides. Four applications of 3 per cent. technical- or aerosol-grade DDT caused severe stunting of the vines and markedly reduced yields. Eight applications of 1 per cent. γ BHC were followed by increased yields in 1951, but did not influence yield in 1950 or 1952. Eight applications of 3 per cent. methoxy-DDT had no deleterious effects in 1950 or 1952, but caused moderate stunting and yield reductions in 1951. Eight applications of either grade of DDT caused severe stunting and yield reductions in each season. Foliage injury was severe in plots treated with DDT and slight to moderate in those treated with methoxy-DDT or copper oxychloride sulphate.

Box (H. E.) & Capps (H. W.). **New Crambine Genera allied to *Diatraea* Guilding (Lepidoptera: Pyralidae). I (Supplementary Note) and II.**—*Proc. R. ent. Soc. Lond.* (B) **24** pt. 9–10 pp. 174–178, 1 pl., 1 fig. London, 1955.

Box (H. E.). **New Crambine Genera allied to *Diatraea* Guilding (Lepidoptera: Pyralidae). III.**—*T. c.* pt. 11–12 pp. 197–200, 1 fig.

In the first paper, *Crambidiatraea*, gen.n., is erected for *Diatraea cayennella* (Dyar & Heinr.) (the type) and three other South American species of no

economic importance, and the synonyms of *C. cayennella* and *Eodiatraea centrella* (Möschler) [*R.A.E.*, A **43** 294] are listed and discussed. In the second paper, *Zeadiatraea*, gen.n., is erected for *D. lineolata* (Wlk.) (the type), and *D. grandiosella* Dyar, *D. schausella* Dyar & Heinr. [**43** 221] and *D. muellerella* Dyar & Heinr. [**43** 220] are transferred to it. *Z. lineolata* occurs in the Bahamas, Cuba, Mexico, British Honduras, Guatemala, Costa Rica, Panama, Colombia, Ecuador, French Guiana, Dutch Guiana, British Guiana, Venezuela, Trinidad, Tobago and Grenada. It is a well-known pest of maize and attacks sugar-cane only accidentally; it has been recorded in error for *Z. grandiosella* in Arizona and Mexico and confused with various sugar-cane borers in British Guiana, Trinidad, Venezuela and elsewhere. *Z. grandiosella* is primarily a pest of maize, on which it occurs in the south-western United States, extending to Kansas and Oklahoma, and Mexico, but it is an important pest of sugar-cane in the coastal region of Sinaloa (Mexico) and has been reported as attacking this crop severely in southern Texas.

Coaker (T. H.). **An Experiment on Stem Borer Control on Maize.**—*E. Afr. agric. J.* **21** no. 4 pp. 220–221, 2 refs. Nairobi, 1956.

An experiment on the value of controlling stem borers, mainly *Busseola fusca* (Fuller) with small numbers of *Sesamia* spp., on maize was carried out in Uganda on a crop grown between August 1953 and January 1954, a DDT dust being used at about 20 lb. per acre. A comparison was made between the blanket method of application, by which a considerable area is treated as one unit and compared with a similar untreated area, and applications to plots less than half an acre in extent, interspersed with untreated plots, the dust being applied by means of a rotary hand duster down the funnel of individual plants. Three applications were made at fortnightly intervals, beginning when the plants were about 9 ins. high. Population counts were made before each application, and the percentages of plants infested on the three dates were 30, 24 and 2 in the plot given the blanket treatment, as compared with 33, 17 and 36 for no treatment, and 24, 14 and 9 in the smaller plots, as compared with 24, 21 and 28 for no treatment. Before harvesting, some two months after the last application, the number of infested plants had increased, possibly as a result of cross-infestation between plots. There was little difference in lodging between infested and uninfested plants, the percentages being 20 and 29, respectively, in untreated plots, and 23 and 26 in treated ones. Differences in mean weight of 25 cobs from infested and uninfested plants were not significant, and there was no significant difference in yield between treated and untreated plots, although feeding had been extensive. It appears therefore, that even considerable stem damage does not necessarily prevent full development of the cob.

Elmer (J. L.) & Smith (R. G.). **Some Pests of Black Wattle in Kenya with a List of other Insects inhabiting the Plantations.**—*E. Afr. agric. J.* **21** no. 4 pp. 230–247, 10 figs., 7 refs. Nairobi, 1956.

There has recently been a considerable increase in Kenya in the acreage planted to black wattle (*Acacia mollissima*), which was introduced into the country for industrial purposes at the beginning of the century. The new plantations are in the European areas, particularly on the Uasin Gishu plateau in the west, where it is estimated that some 60,000 acres are established at 6,000–9,000 ft. above sea level, and the crop is grown on a rotation lasting 8–10 years. Though damage by insects has not yet become acute, the authors give notes on some 25 species that have proved injurious,

with, in most cases, information on the damage caused and on control, together with a systematic list of all the insects collected in the plantations, with indications of their status.

The most important pest, and that dealt with in greatest detail, is *Nematocerus perditor* Mshl., which was first recorded on wattle in Kenya in 1949. Outbreaks of this weevil have varied in severity but appear to be increasing in intensity and were particularly severe in 1954. The injury is caused by the adults, but little is known of its bionomics, and there is some evidence that development takes place in the soil. Infestation begins abruptly, shortly after the onset of the rains, usually in late April, and lasts until August, the weevils migrating from grassland or older trees to adjacent wattle seedlings and spreading rapidly throughout a plantation, sometimes completely destroying it in 24 hours. The stems are severed at ground level during the period of formation of the primary leaves, which lasts 4–6 weeks, so that the plants are killed, and the weevils later attack the leaves, but once the plants have reached a height of 6 ins., the chances of recovery are good.

Experiments on control by means of baits of fresh green vegetation, chopped up, mixed with BHC and laid along the rows of young seedlings, gave promising results in 1949–51, but in view of the practical difficulties in the preparation and frequent renewal of the bait, tests with dusts and sprays were begun in 1953. Good control was given in a poor and very grassy stand of year-old trees by a 0·65 per cent. γ BHC dust, shaken over the plants by hand from a hessian bag at the rate of 15 lb. per acre. Sprays of dieldrin and toxaphene were applied in an adjacent area, where infestation was estimated at about 6,000 weevils per acre and equal numbers of *Megalognatha meruensis* Weise were present, but though dieldrin gave good control of *Megalognatha*, none of the sprays was effective against *Nematocerus*. In a third experiment, on seedlings four months old, a dust of 2 per cent. lindane [almost pure γ BHC] at 15 lb. per acre killed the weevils in 15–20 minutes, but dieldrin sprays proved ineffective.

In 1954, several outbreaks occurred, with estimated populations of up to 400,000 weevils per acre, against which baiting proved inadequate. Good results were given, until rain dispersed the dust, by 2·6 per cent. γ BHC at 20 lb. per acre, but the cost of such treatment is considered excessive. In another area, in which the weevil population was estimated at 200,000 per acre, a bait prepared from 3 lb. maize meal, 1 oz. dust containing 2·6 per cent. γ BHC and ½ pint water was spread in lines one foot wide between the rows of germinating seedlings at about 15 lb. per acre. The results were excellent, and mortality was estimated at 62·5 per cent. in three days. The bait was dispersed by rain and renewed in 6–7 days, and the population was reduced by this to 1,000 or fewer per acre. Further tests showed that the addition to this bait of 1 oz. molasses as an attractant greatly increased mortality, that BHC was superior to DDT, toxaphene and chlordane as the toxicant, and that finely ground maize cobs were as effective as maize meal. The formulation finally evolved contained 15 lb. maize-cob meal, 10 oz. dust containing 2·6 per cent. γ BHC, 10 fl. oz. molasses and 2½ pints water. This could not be tested against *Nematocerus*, but it proved very effective against Coleoptera of similar habits in May 1955.

CARAYON (J.). **Les *Antestiopsis* (Hemipt. Pentatomidae) du caféier en Afrique tropicale française.**—*Bull. sci. Sect. tech. Agric. trop.* no. 5 pp. 363–373, 3 figs., 10 refs. Nogent-sur-Marne, 1954.

The difficulty of identifying the species of *Antestiopsis* on coffee in tropical Africa [*cf. R.A.E.*, A **42** 50] led the author to examine the types of almost

all the African species described in *Antestia* and material from various parts of the continent. He considers that most of the forms referable to *Antestiopsis*, including all those of economic importance, should be included in the species *A. lineaticollis* (Stål), which he treats as polytypic and divisible into a large number of subspecies, themselves having numerous varieties. One of these subspecies is *intricata* (Ghesq. & Carayon) [**41** 14], all stages of which are described; it is the only one so far found on coffee in French West Africa and French Equatorial Africa, being of particular importance in the Ivory Coast and the Cameroons, and it also occurs in the Gold Coast, Belgian Congo, Uganda, Kenya, Sudan and Ethiopia. It is rare except in coffee plantations. Two subspecies that have been confused are *bechuana* (Kirk.) and *ghesquierei*, subsp.n.; characters that distinguish them are given. The former is an important pest of coffee in parts of central and East Africa, where it has usually been identified as *A. lineaticollis* [*cf.* **41** 14], whereas the latter is the form widely distributed on coffee in the east of the Belgian Congo and in Uganda that was referred to as *bechuana* by Ghesquière & Carayon [**41** 14] and as prox. *lineaticollis* by workers in the Belgian Congo [*cf.* **31** 521; **36** 295]. The author also considers that *A. faceta* (Germ.) is a subspecies of *lineaticollis*, although it differs considerably from the latter [and was described before it]. Records of its occurrence on coffee in East Africa and the Congo are due to misidentification; it is a South African species that does not attack coffee and is of no economic importance.

Arabica coffee is the preferred food-plant of these bugs, though they also develop on various wild rubiaceous plants or even plants of other families [*cf.* **31** 520, 521; **42** 118]. On coffee they feed principally on the unripe berries, but young shoots, leaf and flower buds and sometimes even leaves are attacked in the absence of berries [*cf.* **31** 520], though feeding on the latter at some stage in the life of the bug seems essential for the completion of normal development. The damage caused by feeding on the endosperm of the seeds is sometimes increased by fungus infection. Attack on the shoots and leaf buds results in a proliferation of vegetation that favours the bugs and leads to reduced flower production, and flower buds that are attacked dry up. Injury of the last type is rare.

Observations on *A. l. intricata* in the French Cameroons, at an altitude of some 3,300 ft., showed that females were more numerous than males. Development was continuous and all stages were present throughout the year. Eggs were usually laid on the lower surface of the leaves, but sometimes on the berries or shoots, in batches of 9–12, each female laying about 10–14 batches. The duration of development depended on temperature, the five nymphal instars lasting 4–5, 6–13, 10–18, 6–10 and 10–17 days, respectively, in June–September. The natural enemies observed included predacious Mantids and Reduviids, the latter comprising *Pseudophonoctonus formosus* (Dist.), *Hediocoris fasciatus* Reut., *Rhinocoris albopunctatus* (Stål) and *Nagusta punctaticollis* Stål, of which the first was the most important, and three egg parasites, *Anastatus antestiae* Ferrière, *Hadronotus antestiae* Dodd, and *Microphanurus mopsus* Nixon, of which the last was the commonest. The percentage of eggs parasitised was variable, but ranged from 46 to 82 in one region in 1947; it was usually highest in unshaded plantations, but not high enough to afford satisfactory control.

Although *Antestiopsis* develops in widely differing climates, the bugs are sensitive to local conditions, preferring high relative humidity and avoiding sharp differences in temperature. Their distribution in the Cameroons is further affected by the north-easterly wind that predominates in the dry season. This carries flying adults for considerable distances, leads to the invasions" of plantations sometimes reported, and complicates the problem of chemical control, since insecticides such as BHC and DDT,

which are very effective against the bugs, lose their toxicity in a fortnight when applied under tropical conditions.

Nanta [J. P.]. **Les principaux insectes et nématodes nuisibles au caféier en Afrique occidentale.**—*Bull. sci. Sect. tech. Agric. trop.* no. 5 pp. 457–479, 2½ pp. refs. Nogent-sur-Marne, 1954.

This list of coffee pests in West Africa is arranged systematically and has special reference to the Ivory Coast. The information given on the insects is of a general nature and includes notes on habits, the type of damage caused, economic importance and sometimes distribution and control, supported by references to the literature for each species or group.

Hall (D. W.). **The Quality of Groundnuts from the Gambia with special Reference to Insect Infestation.**—*Colon. Pl. Anim. Prod.* **4** no. 3 pp. 227–235, 6 pls. London, 1954.

In view of the poor quality of groundnuts arriving in Britain from the Gambia in recent years, samples of undecorticated groundnuts from commercial shipments and others from local markets were examined, particular attention being paid to damage caused by insects. It was found that 1·2–10·8 per cent. of the groundnuts were damaged by insects (or possibly by fungi) before harvest and 2·4–16 per cent. by insects after harvest, with an average of 5 per cent. in each case. There was further damage due to causes other than insects. The types of insect injury observed are described in detail. Pre-harvest damage is thought to be caused by Lepidopterous larvae and by Hemiptera, but the most important single factor appeared to be post-harvest damage by *Pachymerus* (*Caryedon*) *fuscus* (Goeze), which causes severe damage to the kernels. The eggs of this Bruchid are laid singly on the outside of the pod. The larva penetrates this on hatching, feeds on one of the kernels, destroying up to about 50 per cent. of it, and then pupates in a cocoon either inside the pod or attached to the outside. Though no determination of the effect of insect attack on germination was made, it was calculated that damage to only one kernel in each shell would lead to an overall minimum loss in weight of 3 per cent. The real loss is probably nearer 6 per cent., however, since both kernels are often damaged. Prevention of attack by prompt decortication after harvest is recommended. *Aphanus sordidus* (F.) was common in unthreshed groundnut stacks near Bathurst, but its importance is unknown.

Appert (J.). **Sur l'emploi des insecticides systémiques contre le puceron vecteur de la rosette de l'arachide.**—*Bull. agron. Sect. tech. Agric. trop.* no. 11 (*Ann. Cent. Rech. agron. Bambey 1953*) pp. 193–203, 1 fig., 5 refs. Nogent-sur-Marne, 1954.

Since preliminary tests at Bambey, Senegal, in 1950–51 indicated that parathion and systemic insecticides might prove promising for the control of *Aphis craccivora* Koch (*laburni*, auct.) on groundnuts, to which this Aphid transmits the virus of rosette disease, further experiments were carried out with preparations of parathion, schradan, dimefox (bis(dimethylamino) fluorophosphine oxide), Isolan (1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate), Dimetan (5,5-dimethyldihydroresorcinol dimethylcarbamate), Pyrolan (1-phenyl-3-methyl-5-pyrazolyl dimethylcarbamate), sodium fluoroacetate, and demeton (diethyl 2-(ethylmercapto)ethyl thiophosphate). When groundnut plants, 30 days old, were placed with their roots in nutritive solution containing the toxicants at concentrations that were not injurious

to the plants and Aphids were placed on the latter, only schradan, Isolan and parathion gave results suitable for probit analysis, the concentrations required to give 50 per cent. mortality in 48 hours being within the limits of 0·318–0·46, 10·33–12·49 and 0·628–0·809 per cent., respectively. The other materials appeared to be much less effective. No significant protection 20 days after germination was afforded by soaking the seeds for 12 hours, immediately before sowing, in 0·5 per cent. schradan, dimefox, Dimetan, Pyrolan, Isolan, parathion or sodium fluoroacetate. In tests of emulsion sprays, groundnuts were treated at 150 gals. per acre with 0·25 per cent. schradan, parathion or Isolan, five times at intervals of 15 days, four times at intervals of 20 days, or three times at intervals of 25 or 30 days, the first treatment being applied 30 days after germination and the last 30–40 days before harvest. Groups of Aphids were placed on a plant in the centre of each plot on 24th–25th August, about four weeks after germination, and symptoms of rosette disease appeared on 5th September. Counts of diseased plants were made 60, 90 and 120 days after germination and showed that none of the treatments gave outstanding protection. Schradan was superior to Isolan, and Isolan to parathion, and it is concluded that the first two would need to be applied at least every 15 days and parathion more frequently. The cost was not justified by the increases in yield obtained.

In the final test, a 0·8 per cent. parathion dust and a wettable parathion powder were incorporated into the soil at the time of sowing or one month after it to give about 5·4 lb. parathion per acre, and a spray of 0·5 per cent. schradan was applied after sowing at the rate of about 7·5 pints per sq. yard. These treatments increased the yield of nuts by 10 and 50 per cent. for the dust, 54 and 82 per cent. for the wettable powder and 22 per cent. for the spray, and all the increases except the first were highly significant. None of them covered the cost of treatment however.

Allen (J. D.) & Bull (R. A.). **Recent severe Attacks on Oil Palms by two new Caterpillar Pests belonging to the Limacodidae.**—*J. W. Afr. Inst. Oil Palm Res.* no. 2 pp. 130–137, 4 pls., 1 ref. Benin, 1954

Two Limacodids were observed damaging the leaves of oil palms [*Elaeis guineënsis*] in Nigeria in 1952–53, one of them in Benin Province and the other in Onitsha and Calabar Provinces. The species in Benin was identified as *Parasa* sp. near *serratilinea* B.-B., and the larva, cocoon and adult are briefly described. A severe outbreak began at the main research station in April–May 1953, and a survey of 378 palms showed that damage was then slight on 64, moderate on 9 and severe on 28. In September, the corresponding figures were 42, 47 and 23, respectively, and pupae were found on both damaged and undamaged trees. Infestation spread to an adjacent planting in May. When a survey was made there in October, no living larvae were found, and the percentages of palms on which damage was slight, moderate and severe were 17, 12 and 13, respectively, and 52 per cent. of the trees, both damaged and undamaged, bore cocoons attached to the trunk or base of the fronds. A further planting, about 1¼ miles away, became infested in late August, and young larvae, presumably of a new generation, were present in October. In that month, 5 per cent. of the palms had been attacked severely, 8 per cent. moderately and 37 per cent. slightly, and cocoons were again found on damaged and undamaged palms. An examination of over 700 cocoons from the second planting showed that 0·3 per cent. contained living larvae, 14·2 per cent. living pupae, 35·5 per per cent. dead pupae, most of which were infested by fungi, and 6 per cent. pupae of a Bombyliid parasite, identified as *Systropus* sp. near *tessmanni* (End.); the remainder were empty or contained pupal exuviae. Pupae kept

under a bell jar gave rise to adults within a week, the two sexes being equally numerous.

The other Limacodid probably also belonged to the genus *Parasa*, but no adults were obtained; the larva and cocoon are briefly described. Larvae were observed at Awka, in Onitsha Province, in late June and at Ajalli, about 25 miles away, in late July 1952. Infestation spread rapidly, 58 per cent. of a plantation of 238 palms being damaged within a month at Ajalli. Attempts at Awka to limit the spread of infestation by pruning the lower fronds of heavily infested palms and digging trenches round affected areas had little effect. The population there reached a peak in July and then declined, and the trees had produced new foliage by the end of August. Numerous cocoons were found in the soil round the bases of the affected palms. Outbreaks recurred at both places in June–September 1953 and at Ajalli in January 1954. At Awka, a spray of 5 per cent. DDT in kerosene gave good control of the larvae in early August, but scorched the leaflets, and at Ajalli, a spray of 5 per cent. wettable DDT, though not phytotoxic, gave poor results. Young palms at Abak in Calabar Province were attacked in October 1953, and infestation was reported from seedling palms in a nursery there in January–February 1954.

No species of *Parasa* have previously been recorded as serious pests of the oil palm, and no previous outbreaks of Lepidoptera have occurred on the palm in Nigeria.

Taylor (D. J.). **A Summary of the Results of Capsid Research in the Gold Coast.**—*Tech. Bull. W. Afr. Cacao Res. Inst.* no. 1, 20 pp., col. frontis., 4 pls., 28 refs. London, 1954.

Sahlbergella singularis Hagl. and *Distantiella theobroma* (Dist.) are the most important of the Mirids that attack cacao in the Gold Coast [*R.A.E.*, A **32** 287]. The author summarises the available information on the damage caused by them and the influence on it of shade and soil conditions [*cf.* **41** 238, 442], the life-cycles of the two species [*cf.* **14** 570; **37** 87–88], their alternative food-plants [*cf.* **32** 288; **37** 89; **39** 374] and seasonal abundance [*cf.* **37** 88; **39** 373], the effect of biological and environmental factors on their numbers [*cf.* **40** 365; **41** 442, etc.], and work on their control by insecticides [*cf.* **35** 87; **37** 89–90; **43** 81–82, etc.], natural enemies [*cf.* **37** 89] and cultural methods [*cf.* **39** 373; **40** 365], including the use of resistant varieties [*cf.* **37** 90, etc.].

Nicol (J.) & Taylor (D. J.). **Capsids and Capsid Control in the Belgian Congo with especial Reference to Lukolela Plantations.**—*Tech. Bull. W. Afr. Cacao Res. Inst.* no. 2, 10 pp., 2 pls., 7 refs. London, 1954.

A successful method for the control of Mirids on cacao has recently been developed and generally adopted in the Belgian Congo, where *Sahlbergella singularis* Hagl. is the species of major economic importance [*cf. R.A.E.*, A **19** 190]. This Mirid does not attack cacao until after the formation of the first jorquette, and control measures are not applied until the trees are about three years old. The success of the method depends on the system of cultivation, which consists in planting the trees 10 ft. (formerly 13 ft.) apart in selectively thinned forest, with *Terminalia superba* and *Ficus mucosa* as shade trees, and encouraging a low-branching habit by the regular removal of all chupons after the formation of the first jorquette, so that a closed canopy is formed, the top of which is rarely more than 12 ft. high. Harvesting continues throughout the year and is carried out on the first three days of the week, when each labourer is responsible for a block of

30 acres. On the following three days, the labourers from 20–25 adjoining blocks combine to remove developing chupons, damaged or diseased branches, and diseased pods, and to search for Mirids or recent damage by them; trees on which such damage is found are dusted with 2·2 per cent. γ BHC, which is applied by means of rotary fan or bellows dusting equipment, about ½ lb. dust being used per acre per month. The whole area is covered in a fortnight and losses from pests and diseases are negligible. The method is at present unsuitable for adoption in the Gold Coast, where the cacao trees are neither restricted in size nor regularly spaced.

Monti (J. R.). **La lutte contre le *Stephanoderes hampei* dans la Cuvette centrale congolaise. La campagne de désinsectisation de la caféière de Likete (mai-juin-juillet 1953).**—*Bull. agric. Congo belge* **45** no. 4 pp. 817–885, 17 figs., 10 graphs (1 fldg.), 5 maps (4 col., 1 fldg.), 1 fldg. table, 4 refs. Brussels, 1954. (With a Summary in Flemish.)

In view of the effectiveness of BHC for the control of *Stephanoderes hampei* (Ferr.) on coffee in Brazil [*cf. R.A.E.*, A **41** 253, etc.], investigations were carried out in the Belgian Congo in 1953 to ascertain whether treatment with this insecticide would be practicable there. As local conditions were unsuitable for dusting from the air, as is done in Brazil, sprays were prepared from a 20 per cent. γ BHC wettable powder and applied at the level of the tops of the coffee bushes from a mobile atomising machine that afforded coverage for a distance of over 50 yards from the outlet. The organisation of the work and the preliminary tests that led to the selection of the most effective treatment are described in detail. The latter showed that a dosage of 0·68 lb. γ BHC in 7·6–8·1 gals. suspension per acre, applied with the machine travelling at about one mile an hour, gave effective control for 9–10 days. Since the life-cycle from egg to egg lasts about 25–26 days in the area concerned, three applications per generation were necessary for the maintenance of the toxic deposit. These had to be made at night, when the air was still and saturated with moisture, so that extremely small droplets did not evaporate before reaching the most distant point of impact. The damage caused by *Stephanoderes* is described, and it is calculated that treatment reduced the number of living insects per 100 berries from 60 to 1·5 and the average percentages of injured berries and beans from 24 and 15–16 to 3 and 2, respectively, a result that is considered highly satisfactory and well within the limits of economic possibility. Other insects were also killed, and a list of the various groups concerned is given. Subsidiary tests were also carried out with other insecticides, in 2·5 per cent. dusts or in sprays applied by the atomiser at 0·45 lb. toxicant per acre. Aldrin and dieldrin were initially more effective in sprays than in dusts, a dieldrin spray giving the best results for ten days (approximately 90 per cent. kill), whereas DDT in an emulsion spray gave only 60 per cent. kill in the same period. Counts after a further seven days, however, showed that the dieldrin dust had a more lasting effect than the dieldrin spray, which decreased rapidly in value.

Ossowski (L. L. J.). **An aerial Spraying Experiment against Wattle Bagworm (*Acanthopsyche junodi* Heyl.).**—*Rep. Wattle Res. Inst. Univ. Natal 1953–54* pp. 49–53. Pietermaritzburg, 1954.

Plot tests to determine the effect of aerial sprays of toxaphene in light diesel oil against larvae of *Acanthopsyche junodi* (Heyl.) in the first three instars on wattle [*Acacia*] were carried out in South Africa in 1953 at the same time as a larger experiment already noticed [*R.A.E.*, A **44** 178].

When toxaphene was applied from an aeroplane at 2·25 lb. in 3 gals. oil per acre, 76·1 per cent. mortality of the larvae was observed after 7–13 days, as compared with 24 per cent. for no treatment. There was no significant increase in mortality when the insecticide was applied at 3 lb. in 4 gals. oil per acre. Mortality in the upper half of the crowns was significantly greater, at both rates of application, than in the lower half. It was also observed that mortality varied inversely with the number of larvae per tree, since overcrowding results in a movement to the lower parts and clusters of larvae protect one another [*cf. loc. cit.*]. Many other insects were also killed, the bulk of them being beneficial.

Ossowski (L. L. J.). **A Note on the Use of Insecticidal Fogs against the Powderpost Beetle,** *Lyctus brunneus* **(Steph.).**—*Rep. Wattle Res. Inst. Univ. Natal 1953–54* p. 56. Pietermaritzburg, 1954.

In a test in South Africa in 1953 on the control of *Lyctus brunneus* (Steph.) infesting stacks of boards of *Eucalyptus saligna*, 5 per cent. DDT, 2 per cent. γ BHC and 1 per cent. dieldrin in light diesel oil were applied at the rate of four pints per stack under a tarpaulin by means of a Swingfog fog generator [*cf. R.A.E.*, A **42** 393]. The stacks consisted of boards 1–1·5 ins. thick and had a volume of about 100 cu. ft. each, and treatment lasted 10–12 minutes per stack. The insecticides were applied in June, when larvae and pupae were present, and examination of sample areas on boards in the top, middle and bottom of the stacks in November showed that DDT and BHC both gave complete kill of larvae and 65 per cent. mortality of pupae, whereas dieldrin killed 35·6 per cent. of the larvae and none of the pupae; there was 33·5 per cent. larval mortality in untreated stacks. None of the treatments affected the adults. Reinfestation occurred in all the treated stacks when they were left unprotected.

The same treatments were applied to slightly smaller, uninfested stacks in November, when the adults were on the wing. DDT and BHC afforded protection for 6–8 weeks, with no significant difference between them, and dieldrin for ten days. The untreated stacks became heavily infested 2–5 days after the beginning of the experiment.

Steyn (J. J.). **The Pugnacious Ant (*Anoplolepis custodiens* Smith) and its Relation to the Control of *Citrus* Scales at Letaba.**—*Mem. ent. Soc. S. Afr.* no. 3, [1+] iii + 96 pp., 36 figs., 130 refs. Pretoria, 1954.

Citrus trees on an estate at Letaba in the Transvaal were found to be heavily infested by *Aonidiella aurantii* (Mask.) in 1931, but populations subsequently declined as a result of regular fumigation with hydrogen cyanide, and from 1941 the decrease was rapid. Nevertheless, the Coccid persisted on some trees that were infested by ants, despite fumigation twice a year and occasional oil sprays, and in view of the observed relation between *Iridomyrmex humilis* (Mayr), *Coccus hesperidum* L. and *Aonidiella citrina* (Coq.) in California [*cf. R.A.E.*, A **35** 126], the possibility of a similar relation between *A. aurantii* and ants was investigated in 1947–49. A detailed account is given of part of the work [*cf.* also next abstract] and of studies on the bionomics and control of *Anoplolepis custodiens* (F. Sm.), one of the ants concerned, including information on its systematics and distribution, the structure of its nests, its castes and seasonal life-cycle, the effect of temperature on development, and its seasonal feeding activity. This ant appeared to be confined to hard loamy soil and its nests were commonest along the edges of roads between the *Citrus* plots, in which it was frequently the only ant present, but they also occurred in the walls of

irrigation basins. Feeding activity was positively correlated with temperature and light intensity and negatively with relative humidity. Its most important natural enemies were another ant, *Pheidole megacephala* (F.), which occurred on fine black sandy soil, and Carabids. It preyed on numerous insects, including Lamellicorns and larvae of *Argyroploce leucotreta* Meyr. and attacked and killed small vertebrates, but it subsisted mainly on the honeydew produced by *C. hesperidum*, which occurred only on trees visited by ants, and by other insects; a sooty mould developed on honeydew not removed and caused the leaves to fall, and the feeding of the Coccid caused die-back of the young twigs. *C. hesperidum* was parasitised by *Apanteles* sp., which was responsible for 80 per cent. parasitism on some twigs during December in spite of the ant, and was also effectively attacked by larvae of *Eublemma scitula* (Ramb.). Trees visited by *Anoplolepis* were also heavily infested by *Aonidiella aurantii*, which does not produce honeydew and was attacked by various natural enemies, which are listed. *Aphytis chrysomphali* (Merc.) [*cf.* **26** 456] was the more important of its two parasites and proved able in the absence of *Anoplolepis* to exert considerable control even where host populations were low; various Coccinellids and spiders also appeared of importance in the absence of the ant. The Coccinellids were most numerous on heavily infested trees, which are normally ant-infested, and the presence of even a few indicated that parasitism of *Aonidiella* by *Aphytis* was being prevented by *Anoplolepis*.

The relation between *Aonidiella aurantii* and *Anoplolepis* was investigated in ten plots of orange trees 13 or 30 years old, in each of which two-inch bands of adhesive were applied in September 1947 to the trees in some of the rows to prevent access by the ants. The bands were examined every fortnight, when weeds or low branches by which the ants could reach the trees were cleared away and counts were made of the bands that had been crossed and the Coccids present on the fruits. Banded trees were free from ants at 93·9 per cent. of the inspections. By April 1948, *Aonidiella* was under commercial control on 59–100 per cent. of the banded trees in the various plots but on not more than 28·2 per cent. of the unbanded trees, and frequently on none, and heavy infestations were rare on banded trees, but common on unbanded ones. *C. hesperidum* occurred on over a quarter of the twigs on most of the unbanded trees but, except for 2·5 per cent. of the trees in one plot, the banded trees were almost entirely free. Leaves fell from some unbanded trees in every plot, but from banded trees in only two, in which 2·6 and 27·5 per cent. of the trees were affected. In June 1948, fruit fell from most of the unbanded trees in every plot whereas the percentage of banded trees from which it fell was 0 in two plots, 2·5–43·6 in seven and 80 in one. The percentage of fruits shed per tree did not exceed 10·6 on banded trees but reached 89·5 on unbanded ones, and the value of the yield from banded trees in two plots in which comparisons were made was almost twice that from an equal number of unbanded ones. Further counts showed a positive correlation between the average numbers of ants on unbanded trunks and the percentages of dead wood on the trees. In comparison with unbanded trees, the numbers of Coccinellids and of *Aphytis* adults on the banded trees increased markedly shortly after the bands were applied, but decreased when Coccid numbers became low. During an attempt to determine the effect on beneficial insects of fumigation with HCN and spraying with insecticides against Coccids, the numbers of adults of *Aphytis* that emerged from equal numbers of infested fruits from fumigated and unfumigated trees were 271 and 7,509, respectively. Fumigation and a parathion spray were observed to kill large numbers of Coccinellids, and trees on which a heavy infestation of *Aonidiella aurantii* was apparently completely controlled in six weeks by a spray of DDT in

subsequently became heavily reinfested, presumably because the spray had also killed the natural enemies; the oil alone was of no value against the Coccid.

Since it appeared that *A. aurantii* could be controlled indirectly by eliminating *Anoplolepis*, measures against the ant were investigated. Cultural measures such as disking the soil, the encouragement of a permanent plant cover, and the use of green manure crops tended to render the hard soil favoured by the ant more friable and to hinder nesting and breeding and to favour the presence of natural enemies. The possibility of eradicating the ant by adding insecticides to the irrigation water was investigated by pouring dilutions of insecticides in water into the nests at a rate of 12 gals. per nest, and complete control was given by suitable dilutions of wettable DDT or parathion, pyrethrum extract and Calcid (calcium cyanide). In a field test, an insecticide containing 20 per cent. wettable DDT and 10 per cent. BHC was mixed at a dilution of 124 lb. in 420,000 gals. water and siphoned into the irrigation water on a plot on which uneven ground rendered large quantities of water necessary, and at dilutions of 104 and 50 lb. in 84,000 gals. water to two others, in such a manner that the whole surface of the soil was soaked. These treatments reduced the ant population by about 80 per cent. in 24 hours and destroyed most of the colonies. The ants were not eradicated by $\frac{1}{4}$–$\frac{1}{2}$ oz. calcium cyanide or dusts of Hexidole (20 per cent. DDT and 10 per cent. BHC), Agrocide 7 [2·6 per cent. γ BHC] or 5 per cent. DDT applied to the entrances of the nests or by a dust of 1 per cent. parathion applied over the surface of the soil, though the last remained toxic and repellent for four weeks. DDT dusts applied as barriers round the trunks were effective for three weeks in the absence of rain and irrigation. Smokes of DDT and BHC released by a method already noticed [**35** 211] and pumped into nests in the field gave complete control, but a previously recommended measure by which ants killed by means of calcium cyanide were used as a carrier for sodium fluosilicate to provide a bait for others was of no value, since *Anoplolepis* is not cannibalistic. Tar distillates applied on bands of grease paper were repellent, but injurious to the trunks. Ants were not killed by walking over DDT crystals placed at the base of the tree, but when a two-inch band of adhesive into which a wettable DDT powder had been incorporated was applied to the trunks of 13 trees, they remained free from ants for six weeks. Other banding materials in which DDT was successfully incorporated were raw linseed oil, which remained effective for five months and also prevented termites from constructing earthen tunnels across the bands, and honey, which remained effective for the five weeks during which it was tested.

The use of bands of adhesive was the best of the mechanical methods tested, though where infestation was heavy they were frequently rendered ineffective by the large numbers of ants trapped on them. Empty bottles sunk into the soil were ineffective as traps, as also were wisps of grass tied round the trunks of the trees as barriers. Fine sand applied in a two-inch layer over the exits of the nests gave good control, but is scarce in the area. Barriers of sand built round the trunks on platforms below the crutch were also effective, but were liable to be destroyed by the weather.

Steyn (J. J.). **The Effect of the Cosmopolitan Brown House Ant (*Pheidole megacephala* F.) on Citrus Red Scale (*Aonidiella aurantii* Mask.) at Letaba.**—*J. ent. Soc. S. Afr.* **17** no. 2 pp. 252–264, 3 figs., 12 refs. Pretoria, 1954. **The Effect of mixed Ant Populations on Red Scale (*Aonidiella aurantii* Mask.) on *Citrus* at Letaba.**—*Op. cit.* **18** no. 1 pp. 93–105, 11 refs. 1955.

The first of these two papers contains an account of further work on a *Citrus* estate in the Transvaal in which infestation by *Aonidiella aurantii* (Mask.) was shown to be correlated with the presence of ants. The species concerned was *Pheidole megacephala* (F.), and the investigation was carried out by the same methods and at the same time as the similar ones on *Anoplolepis custodiens* (F.Sm.) [*cf.* preceding abstract]. *P. megacephala*, which was confined to areas of fine black sandy soil and was usually the only ant present in the plots in which it occurred, feeds chiefly at night; it tended *Coccus hesperidum* L. and other honeydew-producing insects and was attacked by *Anoplolepis*. Lemon seedlings to which adhesive bands were applied to exclude it became free from infestation by *Aonidiella* and *C. hesperidum* within 3–4 months, and bands were therefore applied to orange trees in some of the rows in eight field plots in September 1947. By June 1948, 32–99·2 per cent. of the banded trees in the various plots and 0–90·2 per cent. of the unbanded ones were free from infestation by *A. aurantii*; none of the other banded trees showed more than 100 adult females per fruit, as compared with varying numbers of unbanded trees, and there were significantly fewer banded than unbanded trees in each of the lower categories of infestation recognised. Fruits fell from up to 34 per cent. of the banded trees and from up to 71·4 per cent. of the unbanded ones, and the average numbers of fruits shed per tree varied from 0 to 1·2 and from 0·11 to 18·1, respectively; some ant-infested trees were almost completely defoliated, whereas banded trees retained their foliage. It is concluded that *P. megacephala* permits the maintenance of low but potentially dangerous populations of *A. aurantii* and that at least light infestation by the latter is likely to develop on trees with an average of 3–6 ants of this species on the trunk during the day. Since the natural enemies of *A. aurantii* are mostly active by day, *P. megacephala* is probably of less importance in disturbing them than is *Anoplolepis custodiens*; except where infestation by *P. megacephala* was heavy, defoliation and die-back of the twigs often occurred only on portions of trees visited by it, whereas the whole of a tree infested by *A. custodiens* tended to be affected. Since *P. megacephala* preys on larvae of *Ceratitis capitata* (Wied.), *Argyroploce leucotreta* Meyr. and *Heliothis armigera* (Hb.) (*obsoleta*, auct.), its eradication is considered undesirable, and exclusion from the trees is the only measure recommended against it. The best material for this purpose was a paste of wettable DDT powder in raw linseed oil, which is applied as a band two inches wide below the crutch as soon as Coccinellid predators appear in the plots [*cf.* preceding abstract].

About a third of the plots on the estate were commercially free from *Aonidiella aurantii* and had not been fumigated for several years; many others contained only few infested trees, and these were all visited by ants. These plots differed from the others in supporting a variety of ant species, and an account of observations in some of them is given in the second paper. In all, 18 species of ants were collected from them, but many were thought to support at least 30. Most of these did not tend honeydew-producing insects, and the individual colonies were smaller than in plots with only one species. Fights between different species and successful invasions of nests of one species by another were observed to take place, and the small number of ants (often less than five) on a tree at a time is attributed to this competition. These plots also contained other arthropods and vertebrates that were absent from those inhabited by ants of only one species, and Coccinellid predators were extremely scarce in them. In one that had not been fumigated for four years, trees banded to exclude ants were only slightly less infested by *Aonidiella* than the unbanded ones after nine months, and there was no defoliation or fruit drop. Competition between the different ant species evidently reduced populations of those that tended Coccids to

too low a level to permit interference with the natural enemies of the latter, and it is concluded that banding is unnecessary where ant populations are mixed. In another plot that had been repeatedly fumigated and was heavily infested by *Aonidiella*, about half the trees were lightly infested by ants. Nine months after bands had been applied, infestation by *Aonidiella* did not exceed 100 adult females per fruit on any of the trees, but the 21 unbanded trees were markedly more infested than the 189 banded ones, none of which was free from the Coccid; no defoliation or fruit drop occurred, and the ants were evidently too few to interfere markedly with the activity of natural enemies. Trees in the two outermost rows, which are usually most heavily infested, were banded and less heavily infested than unbanded trees in the third row. Temperature and light intensity were relatively low in this plot, and probably inhibited parasitism of *A. aurantii* by *Aphytis chrysomphali* (Merc.); a more marked difference in the infestation on banded and unbanded trees would probably have been evident after a longer period. In both plots, *Coccus hesperidum* was so scarce that surveys were unnecessary.

Matthée (J. J.). **The Effect of constant High Temperatures on the embryonic Development and Pulsations of the lateral Body-wall in *Locustana pardalina* (Walk.) (Orthoptera, Acrididae).**—*J. ent. Soc. S. Afr.* **17** no. 2 pp. 222–231, 2 figs., 12 refs. Pretoria, 1954.

The following is virtually the author's summary. Quiescent eggs of *Locustana pardalina* (Wlk.) [*cf. R.A.E.*, A **42** 34] were incubated at constant temperatures of 40, 42·5 and 45°C. [104, 108·5 and 113°F.]. The highest constant temperature at which development and subsequent hatching were possible was in the vicinity of 40°C. No sign of development was noticed at 45°C., and it is inferred that the growth optimum is at 36°C. [96·8°F.]. The effect of temperature on the rate of pulsation of the lateral body-wall of embryos at two different developmental stages was determined. It was concluded that if used as a physiological indicator, these pulsations would not give a true picture of velocity of embryonic growth.

Gunn (D. L.), Lloyd (J. H.) & Davey (P. M.). **The Choice of Insecticides for destroying Red Locusts in their Outbreak Areas.**—*J. ent. Soc. S. Afr.* **17** no. 2 pp. 246–251, 2 graphs, 6 refs. Pretoria, 1954.

Water is often virtually unobtainable for the preparation of dilute sprays against locusts, and work on the development of methods of applying concentrated sprays at low rates has accordingly been in progress since 1945. Equipment at present in use for control of adult locusts applies concentrated sprays at about 1 gal. (10 lb.) per acre over one or more acres per minute. For this method, it is necessary to know both the amount of active ingredient and the total quantity of material per acre (area-dosage), and attempts were made to determine the area-dosage required for the control of hoppers of *Nomadacris septemfasciata* (Serv.) with a BHC dust in the Rukwa Valley of Tanganyika during the wet seasons of 1952–53 and 1953–54. The dust used contained 50 per cent. BHC (affording 6 per cent. γ BHC), and it was found that a rate of less than 3 lb. per acre gave 96 per cent. mortality of second-instar hoppers, but that rates of the order of about 60 lb. per acre were needed for 90 per cent. mortality of sixth-instar individuals. The area-dosage effective against immature insects depends on their age [*cf. R.A.E.*, A **41** 239] and it has been suggested that size is largely responsible [*cf.* **43** 88]. The authors show mathematically that the ratio of the area-dosages required to control two similarly

shaped insects of similar susceptibility but different sizes should be proportional to the ratio of their linear dimensions. Insects over a wide range of sizes can be shown to be constant in shape if their weight remains proportional to the cube of their length, but when this was tested for hoppers of *Schistocerca gregaria* (Forsk.), the weight of the larger ones was found to be less than expected. The ratio between the length of hoppers in the second and fifth instars did not exceed four, and the area-dosage required for the former should not therefore be increased by more than four for the latter on grounds of size. A similar conclusion can be drawn for *N. septemfasciata*, the size and size-relations of which are broadly similar to those of *S. gregaria*, though it has one more instar, and the observed large increase in area-dosage required for the older hoppers does not therefore appear to be due to size alone.

In field experiments, a 20 per cent. solution of DNC in oil at 1 gal. (2 lb. actual DNC) per acre gives very high mortality of adults of *N. septemfasciata* and, in laboratory tests in which oil solutions of DNC and BHC are applied topically to adult locusts, the amounts of the two insecticides required for almost complete mortality are very similar. To provide an area-dosage of 2 lb. γ BHC per acre, a rate of 32 lb. of the 50 per cent. BHC dust per acre would be required, but since the U.S. Department of Agriculture usually recommends an increase of 50 per cent. in the dosage of a material when applied as a dust instead of a spray, a rate of 50 lb. per acre could be expected to give results comparable with the oil solution of DNC. This finding is in agreement with the results of the field test with BHC dust against hoppers, and indicates that the kill of young hoppers obtained was exceptionally good, either because they are more susceptible than the older ones or because they are present at a time when the grass is short and affords little protection.

BHC is safe and easy to handle, but costly, and DNC is preferable on economic grounds for the treatment of adults and late-instar hoppers. *N. septemfasciata* can increase 100-fold during a favourable season, and at least 99 per cent. mortality is therefore essential. On the basis of the field experiment, the area-dosages of the BHC dust required for 99 per cent. mortality of hoppers in the second, third and sixth instars and for 99·9 per cent. mortality of the sixth-instar hoppers are estimated at 3, 10, 105 and 125 lb. per acre, respectively.

Dürr (H. J. R.). **The Control of the Argentine Ant (*Iridomyrmex humilis*) by Means of DDT, Chlordane and Dieldrin.**—*J. ent. Soc. S. Afr.* **18** no. 1 pp. 7–12, 10 refs. Pretoria, 1955.

The value of barrier sprays of DDT, chlordane and dieldrin in protecting vines in South Africa from infestation by *Iridomyrmex humilis* (Mayr) was investigated in 1952–54, since these materials gave promising results in preliminary tests and had proved effective elsewhere [*cf. R.A.E.*, A **36** 74; **39** 325; **42** 295]. Sprays of 2 per cent. DDT or chlordane and 1 or 2 per cent. dieldrin were applied to the trunks of the vines with their trellis supports and anchor wires from ground level to knee height at a rate of about 1 gal. per 17 vines. When the experiment ended, 17 weeks later, the vines sprayed with dieldrin were free from the ant and only 3 per cent. of those sprayed with DDT or chlordane were infested, whereas infestation among untreated vines amounted to 21–75 per cent. In further tests with dieldrin at 0·5 per cent. in emulsion sprays and at 0·5 and 1 per cent. in wettable-powder sprays applied on 2nd October 1953 in the same manner and at the same rate as before, the treated vines were all uninfested on 17th November 1954, when percentage infestation among the controls ranged

from 47 to 63; despite heavy winter rainfall, only 0·5, 4·8 and 3·2 per cent. of the vines treated with the three sprays, respectively, were infested by *Planococcus citri* (Risso) 59 weeks after treatment, when 35·7–53·1 per cent. of the untreated vines were infested by this mealybug. There was little difference in the cost of the two types of spray at the same concentrations; the emulsion damaged the young shoots, but the wettable powder had no harmful effect.

Hamilton (A. G.). **Parthenogenesis in the Desert Locust (*Schistocerca gregaria* Forsk.) and its possible Effect on the Maintenance of the Species.**—*Proc. R. ent. Soc. Lond.* (A) **30** pt. 7–9 pp. 103–114, 1 pl., 27 refs. London, 1955.

The following is based mainly on the author's summary of experiments carried out mostly at a constant temperature of 90° F. and a relative humidity of 60–70 per cent. but in the later stages at an alternating temperature of 100° F. by day and about 65° F. by night, both of which conditions have been shown to be suitable for *Schistocerca gregaria* (Forsk.) [*cf. R.A.E.*, A **39** 407]. They were begun with females isolated from males in the hopper stage, and six successive generations, all females, were produced from them parthenogenetically up to the time of writing. Their rates of sexual maturation and oviposition were much lower than for females kept with males [*cf.* **44** 151], which implies that mating stimulates the female to oviposit, and their average survival period was three times that of fertilised females. The average number of egg-pods laid per female and number of eggs per egg-pod were similar to those of fertilised individuals, but the average hatch per egg-pod was less than one-third as great. The average rate of development of the hoppers was similar whether they were produced sexually or parthenogenetically, but mortality among the latter was almost twice that among the former. When parthenogenetically produced females were mated, their survival period, rate of maturation and percentage hatch per egg-pod were all similar to those of ordinary stock locusts and the numbers of males and females among their progeny were approximately equal. An Indian claim to have produced both sexes parthenogenetically [**36** 122] is considered unjustified.

Rungs (C.). **Une nouvelle représentation graphique de la grégariosité des populations du criquet pèlerin, *Schistocerca gregaria* Forsk.**—*C.R. Soc. Sci. nat. Maroc* 1954 no. 6 pp. 130–132, 1 fig., 1 ref. [Rabat] 1954.

The author shows that the degree to which populations of *Schistocerca gregaria* (Forsk.) conform morphologically to the extreme phases *solitaria* and *gregaria* can be represented graphically by making use of the E/F and F/C ratios, as delimited by Dirsh in a paper already noticed [*R.A.E.*, A **43** 336]. By drawing lines, at right angles to the axes, through the upper and lower limits of each ratio for each phase, two rectangles can be described, each containing the indices characteristic of one phase; those representing intermediate stages fall between the two rectangles. It is pointed out that these indices refer only to form and therefore do not provide a complete criterion for phase, which also involves characteristic coloration and behaviour. If observations on these two factors are made when the sample is collected, the completeness of phase expression in the population can be rapidly demonstrated, and it should be possible to establish the direction of phase change in populations in which it is taking place. The method also enables the degree of homogeneity with regard to phase, and sometimes origin, within a population to be demonstrated.

Davey (J. T.) & Johnston (H. B.). **The African Migratory Locust** (*Locusta migratoria migratorioides* **R. & F.) in Nigeria.**—*Anti-Locust Bull.* no. 22, [4+] 91 pp., 7 pls., 10 graphs, 3 maps, 54 refs. London, 1956.

Since 1931, the Lake Chad region of northern Nigeria has been regarded as a possible outbreak area of *Locusta migratoria migratorioides* (R. & F.) [*cf. R.A.E.*, A **22** 619], and the authors here summarise, from the literature and unpublished reports, the findings of surveys by earlier investigators, together with those of their own more recent studies, to provide a background for future research. The following is based on their summary of the paper. Three habitats are important and have been studied in some detail; they are the lake shore, the inland plains (characterised by heavy black clay soils) and the temporary marshes (fadamas) within the plains. Rainfall is low in the northern part of Bornu Province (average 24 ins.), but extensive seasonal flooding by the lake, which depends but little on local rainfall, is normal, and there is usually some flooding of the inland plains during the short but often violent rains. Vegetation along the lake shore is of a type adapted to the annual floods; in the inland areas, except in the marshes, it is typical of the Sahel-Sudan zone.

Locusts are most probably indigenous in northern Bornu, and their presence is no longer considered to be due to invasion by swarms from neighbouring territories. Adults may be found along the lake shore throughout the year, but they disappear from the inland areas during the intense dry season. Their fate is unknown; there is little evidence for an embryonic diapause and none for an adult resting stage in soil crevices or other refuges. It is possible that there is a seasonal migration of solitary individuals from habitats that become unfavourable and that some such individuals arrive on the lake shore, where conditions are suitable throughout the year. There may thus be an interchange of population between these two areas; there is no significant difference in the morphometric characters of individuals collected at the same time from the two habitats.

There are probably three generations a year along the lake shore and two in the inland areas. Breeding is possible all the year round, along the shore, but it is seasonal in the inland areas, depending on annual rainfall. Late rains appear to be the most important, and years when populations of very high density were reported corresponded with those having exceptionally late rains.

Morphometric data suggest that the locusts are normally in phase *solitaria*, but the E/F ratios of adults are often atypically high. From time to time, dense concentrations of hoppers and adults are produced, but there is often no change in phase characters. Occasionally, hopper bands, containing individuals with characters of the intermediate *transiens* phase, have been reported both from northern Bornu and from Adamawa Province, some 200 miles to the south. The origin of the Adamawa bands is unknown. Incipient swarms are occasionally produced from such bands, and may cause severe but local damage to grain crops.

The concentrations and hopper bands in northern Bornu are produced from the local *solitaria* population. The essential conditions seem to be abundant late rains permitting successful breeding and leading to a great increase in numbers. If the increase in numbers is accompanied by crowding, partial phase transformation appears to result. The individuals in the hopper bands, however, eventually disperse and disappear. The further transformation to the full gregarious phase has never been recorded in northern Bornu, and it seems that normal conditions there do not permit complete transformation in phase status. The area is therefore considered unlikely to be a true outbreak area, of which the only example definitely known is in the flood-plains of the middle Niger in the French Sudan [**24** 234].

27 11]. It is more closely allied to other regions, such as the Red Sea coast and Bechuanaland, where similar populations occur.

Remaudière (G.). **Étude écologique de *Locusta migratoria migratorioides* Rch. et Frm. (Orth. Acrididae) dans la zone d'inondation du Niger en 1950.**—*Locusta* no. 2, 248 pp., 24 pls., 64 figs., 83 refs. Nogent-sur-Marne, 1954. (With a Summary in English.)

This work comprises a detailed account of investigations on the ecology of *Locusta migratoria migratorioides* (R. & F.) in its outbreak area in the flood-plains of the middle Niger [*cf. R.A.E.*, A **24** 234; **27** 11] carried out in 1950 and is in three sections. The first contains an account of conditions in the area south-west of Lake Debo (French Sudan) [*cf.* **27** 12] in which the investigations were made. In the second, the results are recorded of observations on the annual cycle of the locust, the development of the four generations present during the study, the movements and densities of the adults, with the effect of physical and biological factors on them, and body measurements. There was considerable variation in these last and in morphometric ratios, but densities never reached the level at which incipient swarming occurs. Evidence was obtained suggesting a migration of second-generation adults in August–September into the south of the Farimaké [*cf.* next abstract], an area of dunes with a more or less dense *Acacia* cover and grassy clearings that bounds the flood-plain to the north-west and is not considered part of the permanent outbreak area; third-generation hoppers were found there in November. In 1951, first-generation hoppers in the flood-plain were far too numerous to have been derived solely from the relatively few adults present in non-flooded areas there in the previous November, and it is assumed that very large numbers of adults had developed outside the flood area and entered it when the floods receded. The third part comprises a consideration of the factors that favour the formation of incipient bands and the development of outbreaks. It is suggested that the construction of canals to ensure rapid drainage of the soil might prevent the development of incipient bands in the area, where the flood waters fall very slowly, so favouring the maintenance of large numbers of adults; drought was shown to hinder the development of the eggs in 1950.

Davey (J. T.). **A preliminary Note on seasonal Movements of the African Migratory Locust in the solitary Phase.**—*Locusta* no. 3, 14 pp., 3 pls., 1 fldg. map, 10 refs. Nogent-sur-Marne, 1955. (With a Summary in French.)

Observations on the seasonal movement of adults of *Locusta migratoria migratorioides* (R. & F.) in the solitary phase from the flood-plains of the middle Niger outbreak area to the desert region of the Farimaké and back, for which only circumstantial evidence was previously available [*cf.* preceding abstract], were made in 1953–54, and a detailed account of the work is here given, together with descriptions of the topography, climate and vegetation of the Farimaké. In 1953, populations of adults suddenly decreased in the flood-plains in early June and increased near the borders of the Farimaké in mid-June. The locusts that remained in the plains bred there, but the number of adults did not subsequently rise and since populations near the Farimaké continued to increase and included young as well as older adults, it is assumed that second-generation individuals left the plains soon after becoming adult. At the edge of the plains, populations continued to increase till the second week of July and then rapidly diminished. Small numbers of

adults appeared on the dunes of the Farimaké in late June and July, and numbers continued to increase there until mid-September, the greatest influx occurring from the end of August. Mass migration from the plains had hitherto been assumed to take place in September, and the arrival of adults in the Farimaké in June was probably correlated with exceptionally heavy and early rains. Nymphs were first observed on 19th September, and young adults were numerous soon afterwards throughout the Farimaké; this successful breeding is thought to have been due to the earliness of the rains rather than to their total amount. In an attempt to provide proof of a return migration to the flood-plains, over 53,000 young adults were marked with a dye by hand or spray guns in October–December. Four were subsequently recovered, between November and January, the first two in the south of the flood-plains and the others further to the north-east and this, combined with differences in the population densities on the flood-plains and in the Farimaké in January, in the sex ratios (more females than males tending to migrate), and in the degree of sexual maturity, indicated that most of the locusts migrated to the southern plains, which were the first to become free from flood water, and later spread out to repopulate the northern plains as the floods there declined. Some evidence was obtained that these movements take place at night and that they may be related to temperature or the direction and force of the wind, or both.

In view of the evidence that breeding occurs many miles outside the known outbreak area, work in an additional belt some 18–19 miles wide outside the former limits was authorised in 1951. Control measures in the Farimaké are unlikely to be effective or economically practicable, since the hoppers do not form bands there and the adults, even when numerous, may not give rise to any on returning to the flood-plains.

Chapman (R. F.). **Responses of** *Locusta migratoria migratorioides* **(R. & F.) to Light in the Laboratory.**—*Brit. J. Anim. Behav.* **2** no. 4 pp. 146–152, 9 figs., 13 refs. London, 1954.

The following is the author's summary. It was shown by means of an actograph that, at constant temperature, hoppers of *Locusta migratoria migratorioides* (R. & F.) are more active in light than in darkness. The period of quiescence after feeding was about three hours in light and much longer in darkness. Activity began with light, and not as an independent diurnal rhythm. An apparatus in which the phototactic response was investigated is described. Hoppers of all instars showed a positive movement towards the light. The intensity of this response was greatest in the middle of the instar. Hoppers appeared to be sensitive to red light. Unilaterally blinded hoppers performed circus movements in a uniform light, the rate of turning increasing with light intensity. In experiments with two lights, some hoppers went straight to the lights, others between them. Unilaterally blinded hoppers moved straight towards a light, sometimes after some initial circus movements. It is concluded that both tropotactic and telotactic mechanisms are available.

Chapman (R. F.). **Some Temperature Responses of Nymphs of** *Locusta migratoria migratorioides* **(R. & F.), with special Reference to Aggregation.**—*J. exp. Biol.* **32** no. 1 pp. 126–139, 4 graphs, 27 refs. London, 1955.

The following is largely based on the author's summary of this account of laboratory experiments on the temperature responses of hoppers of *Locusta*

migratoria migratorioides (R. & F.). When hoppers were placed singly in a temperature-gradient and left for half an hour, the total time spent without movement by hoppers of all instars was longest at a temperature that remained constant from instar to instar but increased with the preconditioning temperature. The rate of movement of first-instar hoppers increased in a linear manner with temperature up to 25°C. [77°F.], and then decreased. It is suggested that these findings provide quantitative data supporting J. S. Kennedy's theoretical conclusion in a paper already noticed [*cf. R.A.E.*, A **28** 28] that negative thermokinesis could predominate in the field only between 20 and 40°C. [68–104°F.]. Experiments with hoppers in cylindrical cages with a diameter of 8 ins. and a height of about 15 ins. showed that group formation depends on a patchy temperature field rather than on any particular temperature, and that environmental conditions are more important than mutual responses of the hoppers. Hoppers less than three days old, as well as older ones, formed groups under conditions of patchy temperature. Surface temperatures appeared to be more important than air or body temperatures in the initial formation of groups. Basking groups induced by local radiant heat in a cage rather less than 6 ft. in length and height and rather less than 4 ft. in width did not differ in form from the groups in the smaller cages formed in the absence of radiant heat. Surface texture was shown to be unimportant in group formation, hoppers always collecting on the hotter surface even when temperature differences were of the order of only 1°C. [1·8°F.]. The groups were shown to be in a very dynamic state, with hoppers continually coming and going. The average time spent in a group by any one hopper was 6 min. 46 sec. Formation of basking groups in the field is considered to depend on the physiological state of the hoppers, which has also been found by other workers to be of importance in the behaviour of Acridids [*cf.* **23** 612; **39** 189], rather than on any definite temperature.

Joyce (R. J. V.). **Large-scale Spraying of Cotton in the Gash Delta in eastern Sudan.**—*Bull. ent. Res.* **47** pt. 3 pp. 399–413, 5 refs. London. 1956.

The following is substantially the author's summary. In view of the increase in the yield of cotton obtained in the Sudan Gezira as a result of spraying with DDT [*cf. R.A.E.*, A **43** 441], early-sown cotton over about 23,150 and 7,000 acres in the Gash Delta, in the eastern Sudan, where cotton is grown under controlled flush irrigation, was sprayed once and twice, respectively, by aircraft in 1952–53 with about 1 lb. technical DDT in about 2 gals. spray per acre. Observations were made on the incidence of insect pests at 30 points selected more or less at random in treated and untreated areas. One application made 50–70 days after sowing gave satisfactory control of *Empoasca lybica* (de Berg.), *Hercothrips fumipennis* Bagn. & Cam. and *H. sudanensis* Bagn. & Cam. throughout the growth of the crop, but little lasting control of *Podagrica puncticollis* Weise. A second application made 70–90 days later had little effect on any of these pests, which then occurred in low numbers. Counts of bollworms were made between December and March (the main fruiting period), and over 70 per cent. more larvae of *Diparopsis watersi* (Roths.) and 40 per cent. more larvae of *Earias insulana* (Boisd.) were observed on sprayed than on unsprayed cotton. Significantly more larvae of *D. watersi* and significantly fewer of *E. insulana* were found on cotton that received two applications than on cotton that received only one. Moreover, the estimated total number of fruits per plant damaged by or shed in association with bollworm attack between January and March was over 30 per cent. greater on sprayed than on

unsprayed cotton, and there was nearly 30 per cent. more bollworm damage to nearly mature bolls. Yields of seed cotton were lowest, by a significant amount, from cotton sprayed twice. Cotton sprayed once yielded less, but not significantly so, than unsprayed cotton. Yield was negatively correlated with the number of applications, but the correlation coefficient just failed to reach significance. Further analysis of yield data from areas where yield differences were most marked indicated that *D. watersi* lowered the yield potential of the crop as expressed by fruit production and retention, as a result of the continuous shedding of damaged fruits. Attack, however, was concentrated on cotton with the best yield potential. The effect of spraying was to increase the numbers of *D. watersi* and thus to give rise to excessive shedding, increased production of fruit primordia, an increased number of damaged bolls, and finally reduced yield. It is concluded that any benefits conferred by the elimination of leaf-feeding insects were lost through increased bollworm attack, and that the latter reduced the yield to less than that of unsprayed cotton.

Bowden (J.). **New Species of African Stem-boring Agrotidae (Lepidoptera).** —*Bull. ent. Res.* **47** pt. 3 pp. 415–428, 23 figs., 2 refs. London, 1956.

This paper supplements one already noticed [*R.A.E.*, A **41** 68] and contains descriptions, all from adults of both sexes, of three new genera and six new species. A key to the genera, including the six dealt with in the earlier paper, is presented. The three new species for which new genera are erected, all from the Gold Coast, are *Carelis albula*, reared from *Scleria verrucosa*; *Poecopa mediopuncta*, from *Rottboellia compressa*, *Setaria chevalieri*, *Pennisetum purpureum* and *Sorghum arundinaccum*; and *Manga basilinea*, from *Pennisetum* sp. and millet (*P. typhoides*). They are of interest because the larvae of the first two greatly resemble those of *Sesamia* spp., and the adults of *M. basilinea* resemble those of *Busseola fusca* (Fuller). The other new species are all referable to the genus *Busseola*, an emended description of which is given. They comprise *B. quadrata*, from *Pennisetum purpureum*, maize and *Setaria chevalieri* in the Gold Coast; *B. phaia*, from *P. purpureum* in Southern Rhodesia; and *B. segeta* from *P. purpureum*, *Sorghum verticilliflorum* and *Panicum maximum* in Uganda. *B. quadrata* and *B. segeta* greatly resemble a rufous-ochraceous and *B. phaia* an infuscate form of *B. fusca*. This last species has been reared from *Pennisetum purpureum* in Southern Rhodesia. *Poconoma serrata* (Hmps.) also resembles *B. fusca* and is known to breed in *Pennisetum purpureum* in Uganda, and a key is included for the separation of these five similar species with a common food-plant, of which only *B. quadrata* has not as yet been recorded from East or Central Africa and only *B. fusca* is at present known to cause severe injury to cereals.

Phillips (J. S.). **Immature Nutfall of Coconuts in the British Solomon Islands Protectorate.**—*Bull. ent. Res.* **47** pt. 3 pp. 575–595, 1 pl., 2 maps, 12 refs. London, 1956.

The author reviews at some length the literature on the immature nutfall of coconut caused by *Amblypelta cocophaga* China in the Solomon Islands [*cf. R.A.E.*, A **40** 208, etc.] and on attempts to control this Coreid by means of introduced parasites, none of which proved successful. In addition to those already noticed [**30** 321; **40** 209], the parasites included the Tachinid, *Pentatomophaga bicincta* de Meij., which attacks the adults and last-instar nymphs of *A. lutescens* (Dist.) in Queensland and was introduced

into the Solomon Islands in 1938–39; however, it there showed a marked preference for the more numerous *Axiagastus cambelli* Dist., on which it failed to develop. No larvae of *Trichopoda pennipes* (F.), which was released on an affected estate on Malaita in 1950 [**40** 209], were found in over 5,000 Coreids, including 2,000 examples of *A. cocophaga*, examined during 1951–52.

A further survey of the position with regard to nutfall was made in 1952–53, and the following is largely taken from the author's summary of the results. There was a further improvement in the yield and an extension of the area of recovery in the plantations on Guadalcanal previously investigated [**40** 208]; *Pheidole megacephala* (F.), which does not control *Amblypelta*, had entirely disappeared, and in many parts the beneficial *Oecophylla smaragdina* (F.) had been driven back by the less effective *Anoplolepis longipes* (Jerd.), which had become the dominant ant. The only areas in which nutfall still occurred were occupied by *Iridomyrmex myrmecodiae* Emery. A fuller examination of these and other plantations did not support the theory that recovery was due to ecological changes in the undergrowth [**40** 208], for these had occurred throughout the Protectorate and yields had decreased and *Pheidole* had greatly extended its pre-war area of occupation in most of the other plantations. The areas in which recovery had occurred adjoined military installations that had been subject to weekly sprays of DDT applied from the air against mosquitos during and after the late war, and it is suggested that this had affected *Amblypelta* directly and also indirectly by exerting a differential effect on the populations of *Pheidole* and *Oecophylla*. This view was confirmed in small-scale tests in which sprays prepared from proprietary emulsion concentrates of DDT and chlordane were applied to the trees and affected the harmful ants, *Pheidole* and *Iridomyrmex*, very severely and the beneficial ones, *Oecophylla* and *Anoplolepis*, far less. In plots with mixed ant populations, it was found possible to effect a temporary increase in the number of palms occupied by the beneficial ants by spraying the bases with DDT. With the equipment available, it was not possible to spray the boles and crowns; consequently, the trees often became reinfested by *Iridomyrmex* from colonies in the crowns. In laboratory tests with Coreids other than *Amblypelta* (which had become very scarce), the sprays were found to kill the bugs by contact and to leave a deposit that remained toxic to them for a considerable period.

Salmond (K. F.). **The Insect and Mite Fauna of a Scottish Flour Mill.**—*Bull. ent. Res.* **47** pt. 3 pp. 621–630, 6 refs. London, 1956.

The survey with which this paper is concerned was carried out in a combined flour, oatmeal and provender mill, one of the most northerly in Britain, between August 1948 and September 1949. A list of the 85 species of insects and eight mites collected is given, together with notes on their distribution in the mill and its contents, their abundance and, in some cases, their associations with other species. About a quarter of the insects appeared to be of some economic significance. The three most important in interfering with the milling processes and contaminating the finished products were *Ephestia kuehniella* Zell., *Gnathocerus cornutus* (F.) and *Tribolium confusum* Duv. They were most numerous on the upper floors, where temperatures were higher than at ground level, and the last two occurred in the flour-milling machinery, where temperatures were higher than elsewhere in the section. *Endrosis sarcitrella* (L.), *Tipnus unicolor* (Pill. & Mitt.) and *Cryptophagus cellaris* (Scop.) appeared to fall within the category of hardy insects of Solomon & Adamson [*R.A.E.*, A **43** 342]. The results are briefly compared with those obtained in an unheated granary [**43** 344].

Distribution Maps of Insect Pests.—Series A, nos. 67–72. London, Commonw. Inst. Ent., 1956.

These maps are nos. 67–72 of a series already noticed [*R.A.E.*, A **40** 203; **44** 276] and deal, respectively, with *Aphis maidis* Fitch, *Laphygma frugiperda* (J. E. Smith), *Operophtera brumata* (L.), *Lobesia botrana* (Schiff.), *Paralobesia viteana* (Clem.) and *Contarinia sorghicola* (Coq.).

PAPERS NOTICED BY TITLE ONLY.

ZOLOTAREVSKY (B.). **Historique de l'organisation internationale de lutte préventive contre le criquet migrateur africain** [*Locusta migratoria migratorioides* (R. & F.)]. [*In French & English.*]—*Locusta* no. 1, 32 + 32 pp., 4 pls., 5 maps, 24 refs. Nogent-sur-Marne, 1954.

ALBRECHT (F. O.). **The Anatomy of the Red Locust** (*Nomadacris septemfasciata* **Serville**).—*Anti-Locust Bull.* no. 23, [1 +] 9 [+2] pp., 17 pls., 16 refs. London, 1956.

MILLER (N. C. E.) & CHINA (W. E.). **A new Genus and Species of Miridae** [*Carvalhoia arecae*] **from** *Areca catechu* **in South India** (**Hemiptera Heteroptera**).—*Bull. ent. Res.* **47** pt. 3 pp. 429–431, 1 fig. London, 1956.